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AMERICAN MACHINIST

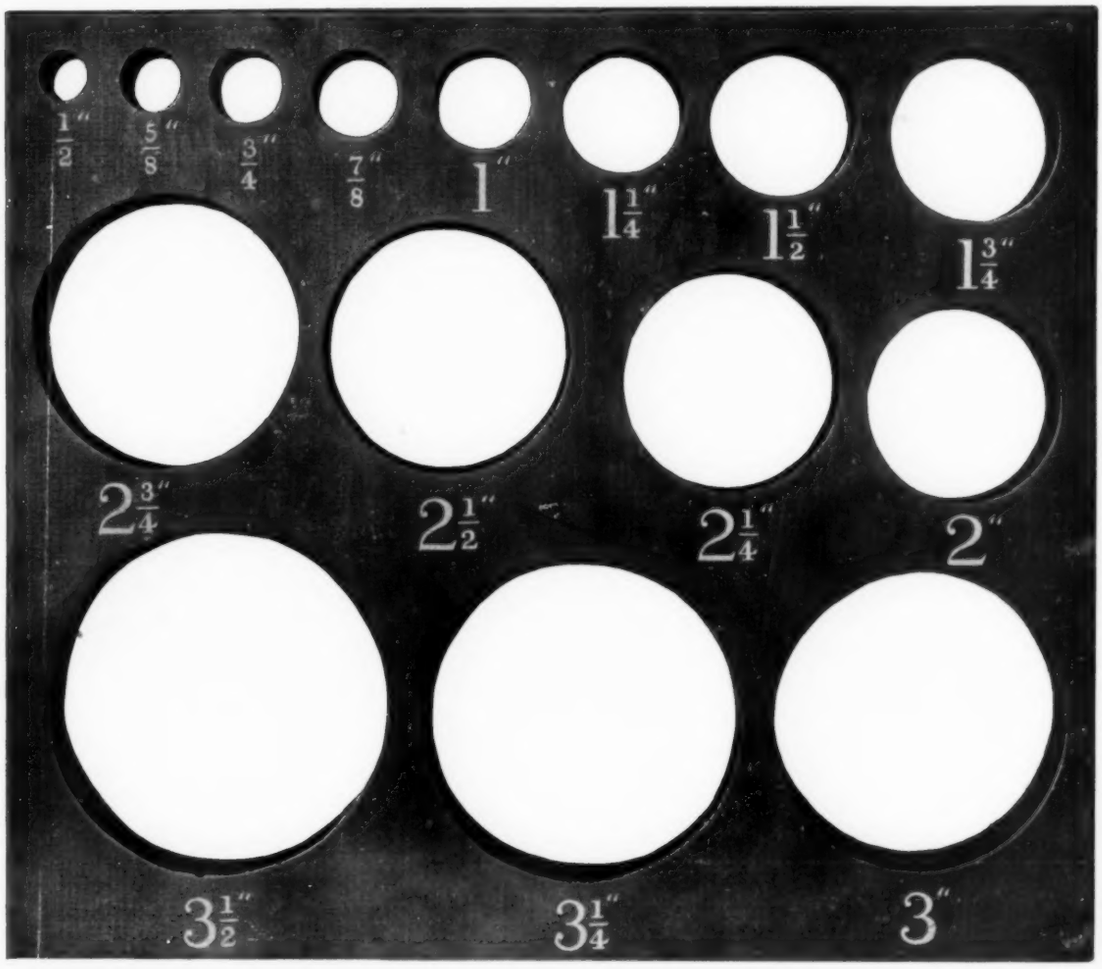
A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 25. WORLD BUILDING, NEW YORK. No. 36.

Index to Advertisers and Classified Index Following Reading Matter.

CHALLENGE



The above 1-inch cast-iron plate contains fifteen "through" holes, ranging from ½ inch to 3½ inches in diameter, all of which were drilled from the solid at correct cutting speeds. The work was performed on one of our **No. 1 Improved Plain Radial Drills** in exactly 26 minutes and 53 seconds, including the time consumed in changing tools, speeds and feeds, together with the making of all adjustments.

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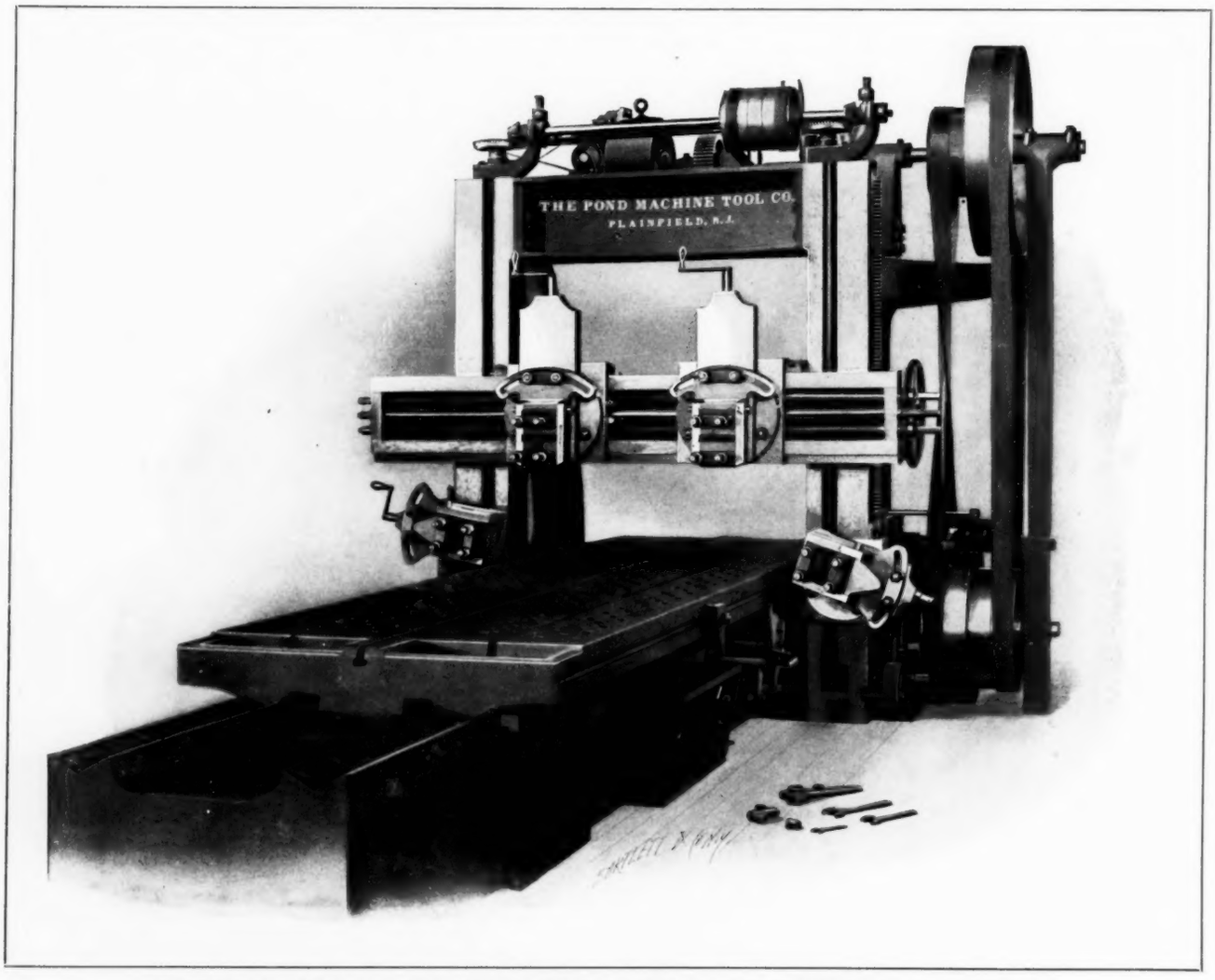
POND PLANERS



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Pattern Shop Wrinkles.

GLUE SCRAPER — FILLET BLOCK — BANDSAW WORK GUIDE—HOLDER FOR THIN WORK ON BUZZ PLANER—SHARPENING GAGES—ELLIPSOGRAPH—A CUTTING-OFF GAGE FOR CIRCULAR SAW—APPLYING LEATHER FILLET, ETC.

BY JOHN M. RICHARDSON.

The following pattern-shop kinks, wrinkles, tricks or devices are some I have seen in quite a number of shops in New England. Some are of more importance than others, and possibly the reader may find at least one among them of some use to himself should occasion require.

Fig. 1 is a glue "snagger" or scraper. In gluing up stock, more or less of the glue always oozes through the joints, and hardens like glass, dulling the buzz planer badly unless removed. This tool is simply a heavy bastard file, with the teeth ground off on the end (the inner face of the end is sufficient) and bent to the form shown in the cut. The edge is slightly beveled so that it will take hold easily and can be readily ground as it becomes dull.

Fig. 2 is a section of a fillet block, which is simply a long strip about 2 inches square and any length, with V-grooves of different sizes cut in the sides, and at the extreme end of each V a screw is inserted for a dog, to keep the fillet stock from sliding along while being planed. This does not have the use it did formerly, as leather and manufactured wood fillets have almost superseded the hand-planed kind.

Fig. 3 is a holder to use on the bandsaw when splitting thin strips dangerous to hold by hand. The piece to be sawed is held firmly against the face or vertical edge of the holder, which insures a true cut without danger of tipping sideways. The bars are placed in the holder to help keep it square, and one of them makes a nice handle to grasp, when holding it in position.

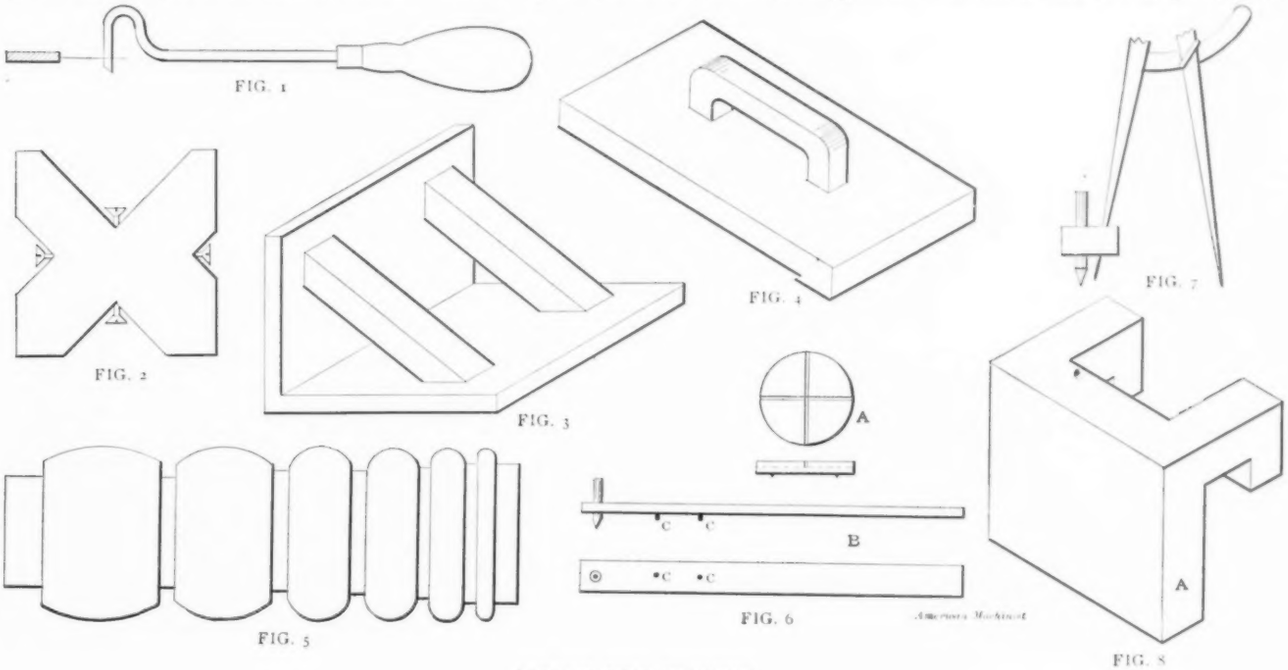
Fig. 4 is not a scrubbing brush minus the bristles, though it somewhat resembles one, but a holder to use with thin work on the buzz planer. A thin piece is dangerous to hold with the hands, and when of any considerable width is almost sure to come concave, owing to the pressure exerted in holding being in the middle of the piece, and the edges springing away slightly. For this reason the holder should be of some width, as well as length, so that an even pressure can be brought to bear over nearly the entire width of the work.

Fig. 5 is a wooden roll, 3 inches in diameter or thereabouts, of very soft pine, with a series of rounds of different radii turned on it, to fit different sizes of inside gouges. It is a somewhat difficult matter to sharpen an inside gouge by hand, so that it will shave en grain and leave a smooth, shining cut without showing any lines or breaks in the grain. This roll is for putting almost a razor edge on these tools, and is used in the speed lathe. A stick of rouge is held against the curved faces while in motion, until they are thoroughly charged with it, then the gouge, after being first sharpened by hand, is held lightly on the proper curve, holding it so that the roll runs away from, instead of towards, the tool. Lightly touch the back as well as the inside, to take off all trace of a feather edge, and you will be surprised at the result, when the gouge enters the wood.

Fig. 6 is an elliptical trammel which can be made in a few minutes. *A* is a little round block about 3-16 inch thick, with two spurs in the bottom. On the top side two grooves are made with the hack-saw, exactly at right angles, and about half-way through the piece. *B* is a light stick or bar with a pencil inserted in the end, so that when the bar is over the round block, the point will just touch the work, and make a line. *c c* are two little wire nails put in the bar, one the length of half the major axis of the ellipse from the pencil point, and the other the distance of half the minor axis from it. These nails must be of the right size wire to move freely in the saw cuts without any side shake, and must be cut off so that they will not quite reach the bottom of the sawed grooves. To operate, place the piece *A* in position, the grooves in line with the axes of the ellipse to be described; then set the bar *B* over it with the points *c c* in two grooves at right angles to each other, and lightly turn the bar like a pair of dividers. The points follow the saw cuts all by themselves, and the pencil does the rest, making a very true ellipse. This tool, of course, has its limitations. It will not make a very elongated ellipse, as the diameter of the block *A* must be at least slightly over twice the length between *c c* and the distance from the pencil point to *c* has to be somewhat over the radius of the block; but for one somewhere near approaching a circle it is all right.

Fig. 7 explains itself, being a little block with two holes, one for a lead pencil and one for the divider leg, as an attachment for any divider in striking a circle in pencil.

Fig. 8 is a little device to hang over the guide rest on a circular saw which stands parallel to the saw blade, and can be either of wood or iron. It is a stop to use when cutting a number of short pieces the same length, with the sliding cross rest, and is placed a little toward the operator from the saw itself. The stock to be sawed is held against the cross rest, sliding it along until it just touches this piece, and then



PATTERN SHOP WRINKLES.

running it through the saw. This prevents the blocks sawed from catching or buckling between the blade of the saw and the long guide rest, the clearance being equal to the thickness of the overhanging piece *A*.

In attaching loose pieces to a pattern, it is very often desirable to have a fillet, and this must unavoidably have an exposed feather edge. A feather edge of wood breaks off with a breath, almost. One of leather will not break off, but is weak and pliable, and needs a backing. This latter feature is the trick I will explain: Take

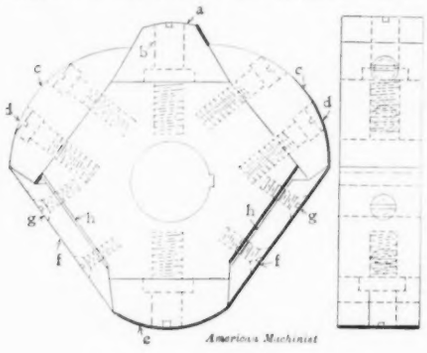


FIG. 1. ADJUSTABLE CAM.

a strip of thin, closely-woven cotton cloth, and before using the leather glue this to the back of the loose piece, perhaps ½ inch from the edge, letting it project outside as much as it happens to. Now place the loose part firmly in position against the pattern, and apply the leather fillet precisely as if there was nothing loose at all. When dry, remove, and with a sharp knife point pare off the cloth just even with the edge of the leather and shellac thoroughly all over both sides. It is surprising what a rigid, durable edge this cloth backing makes for the leather, and no matter how irregular the outline of the back of the loose part may be the leather readily conforms to it, but if of wood it might be a long, tedious job to cut the fillet, and unsatisfactory in the end as well.

Adjustable Cam—Making a Small Cup—Fixture for Cutting Off Wire.

BY VER. I. NIER.

Fig. 1 shows an adjustable cam which, being used on a machine having very delicate mechanism, must do its work at the proper time. A number of cams were made, but none that would time exactly. At last this adjustable one was made and found to be just what was needed. This cam has, properly speaking, only two working points—those that contain the collar screws. In constructing the cam, the body or center piece with five unequal sides was made first. The first working point was at *a* and this piece was fastened to the body with the collar screw *b*. The two side lags *c c* were next completed and these two parts which were equal in size were held by the screws *d*. The piece *e* was then fitted and secured in the same manner as *a*. The two side clamps *f f* were fastened with the bevel head screws *g*. All the parts fitted previously to *f f* were made with the bottom of each forming a tight joint with the base. Each of these two clamps was fitted to allow space between its under side and the body of the cam. All of these parts were of tool steel hardened and tempered; the screws being soft steel were case-hardened. The cam, being put on the driving shaft of the machine and fastened with a key, served to drive an arm forward at given intervals. The work was of such a nature that it was necessary to drive this arm a given distance, and as there were various sizes of material used, the movement of the lever was different for each size. When it was desired to push the lever forward a greater distance, the screw *b* was backed out of the body of the cam, into which it was tapped, and the collar raised the part *a;* when the piece had been raised to the desired hight, the parts *c* were fastened tightly by the screws *d*, thus clamping the part *a* firmly. The throwing of the lever forward naturally required the same decrease in motion on the backward stroke; this was obtained by backing the collar screw in part *e* the desired distance. The clamps *f* being tightened by the screws *g* the part *e* was held fast.

The value of this cam will be seen at once; it not only saved the making of a series of cams for the various sizes of stock, but also prevented the annoyance and loss of time caused by changing cams.

Fig. 2 shows a punch and die designed

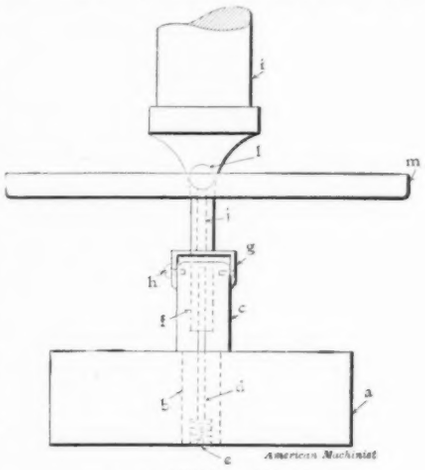


FIG. 2. MAKING A SMALL CUP.

down at one end to fit the hole in the base and having a hole 1-16 inch in diameter drilled through the entire length. This hole was then enlarged at the bottom for the screw *e* and the opposite end was counterbored 7-64 inch in diameter, or the size of the blank to be cut. A piece of wire 1-16 inch in diameter and 1 inch long was then cut and the ends faced and hardened. The stripper *g* consisted of a piece of sheet steel, formed as shown in drawing, one side hooking on a pin projecting from the spindle *c* and the opposite side being held by a screw *h*. Through this stripper was drilled a hole the diameter of the cutting plunger. The spindle was then hardened and tempered and the pin *d* put into place with its lower end resting on the screw *e*. The plunger was made of a piece of tool steel ¾ inch in diameter and 2 inches long. The upper end *i* was turned ⅝ inch in diameter to fit the collet in the press, and the lower end was turned 7-64 inch in diameter to fit the cut-

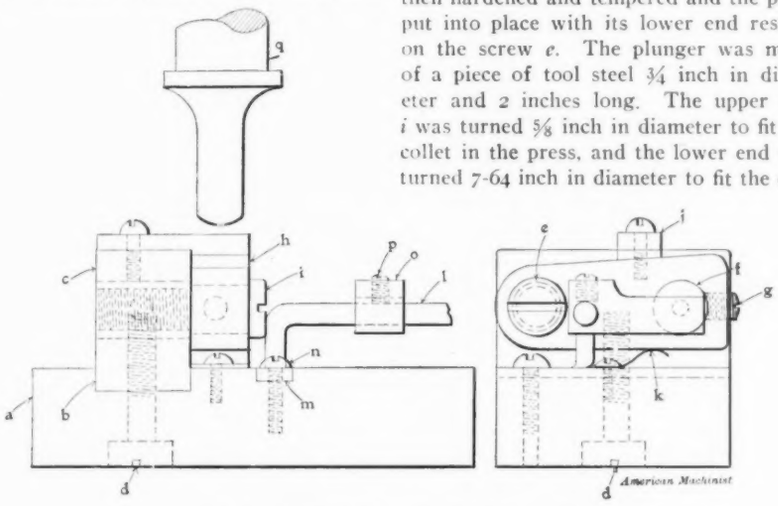


FIG. 3. FIXTURE FOR CUTTING OFF WIRE.

ting part of the die, or the large hole in the spindle. In the small end was drilled a 5-64 inch hole ½ inch deep; this hole being the same size as the finished cup. The hole *l*, 5-32 inch in diameter, was then drilled, meeting the small hole drilled from the end. The plunger was hardened and the cutting end was ground. The pan *m*, made of a piece of brass 3⅛ inches in diameter, with the edge turned up at a right angle 3-16 inch high, was drilled through the center and placed on the plunger in the position shown. The tools now

to perform the two operations of cutting and drawing up small cups on a single-action press. These cups were made of thin sheet brass drawn into the shape of a half ball 1-16 inch in diameter, the work being done on a foot press. The base *a* consisted of a piece of tool steel 2 inches long, 1½ inches wide and ⅝ inch thick. Through the center of the base was drilled the hole *b* ¼ inch in diameter, and the piece was then hardened. The tool *c* was next taken in hand. This was a piece of ⅜-inch Stub's steel 1¼ inches long, turned

ready for use are set in the ordinary manner in a foot press. The stock being placed in position, the ram of the press descends and the blank is cut and forced down upon the pin *d*, the cup being forced up into the hole *j* in the plunger. The cups gradually fill this hole and, reaching the hole *l*, fall out into the pan.

The fixture shown in Fig. 3 was designed for cutting wire of various sizes and lengths and can be used in a small press of any description. The base is of tool steel—milled on all surfaces—3 inches long, 1½ inches wide, and ⅝ inch thick. The tool-steel block *c*, 1½ inches long, ⅞ inch wide and ⅝ inch thick, was fitted to the slot *b* (milled in the top of the base) and fastened by the screw *d*. Two holes —*e* and *f*—were drilled through the piece *c*, *e* being tapped ¼ inch and *f* being a ⅜-inch reamed hole. In the end having this reamed hole a hole was drilled and tapped for the set-screw *g*. The part *h* was next taken in hand and finished as per sketch. This piece, which was 1½ inches long and ⅜ inch thick, was ⅝ inch wide at one end and ½ inch wide at the other. It was drilled at *e*, *f* and *g*, these holes being located to correspond with the holes in block *c*. The hole at *e* was drilled and reamed for the 5-16 inch shoulder screw *i* upon which the piece swiveled, and the hole at *f* was reamed to ⅜ inch. The end of the piece was drilled and tapped for the small set-screw. A strip *j* was fastened to the top of block *c*, and when *h* was held up against this strip by the flat spring *k* the ⅜-inch holes in *c* and *h* were exactly in line. Into the two ⅜-inch reamed holes were fitted bushings—cut from ⅜-inch Stub's steel—as long as the thickness of the parts into which they fitted. These bushings were drilled the size of the wire to be cut and were hardened, as were also the parts *c* and *h*. The bushings were then placed in their respective places and the faces of the two pieces ground until a perfect surface was obtained on each. The parts were then replaced in their respective positions and the gage *l* was taken in hand. This gage was made of a piece of ⅛-inch Stub's wire, bent in the form shown in the sketch, the bottom being flattened to fit the slot *m* milled in the base of the tool. The gage was fastened by the screw *n*. The opposite end of the gage projected from the face of the tool 6 inches, as the longest piece of wire to be cut measured 5½ inches. On this gage was fitted the stop *o*, which was held in any desired position by the screw *p*. The plunger *q* was made of a piece of ¾-inch tool steel, with one end turned to ⅝ inch to fit the hole in the ram of the press. The lower end was turned to ¼ inch in diameter, and this end was rounded to serve as a rocker. The plunger was then hardened and tempered. In using this device it is placed in the press in the desired position and the wire is pushed through the holes in the bushings until it touches the stop *o*, which has been properly set. When the press is started, the small end of the plunger comes in contact with the piece *h*, forcing it down and cutting the wire. As the plunger returns, the spring *k* forces *h* back until it comes in contact with stop *j*. The holes in the bushings are now in line ready for the wire to be fed through again. When a change of wire is made the bushings are changed to suit; after loosening the screw *g* the bushing can be slipped out and replaced by the proper size. This tool cuts the wire clean, leaving the end flattened but very little from the effects of the operation. The tool can be operated continuously after a little experience.

A Reversible Milling Fixture.

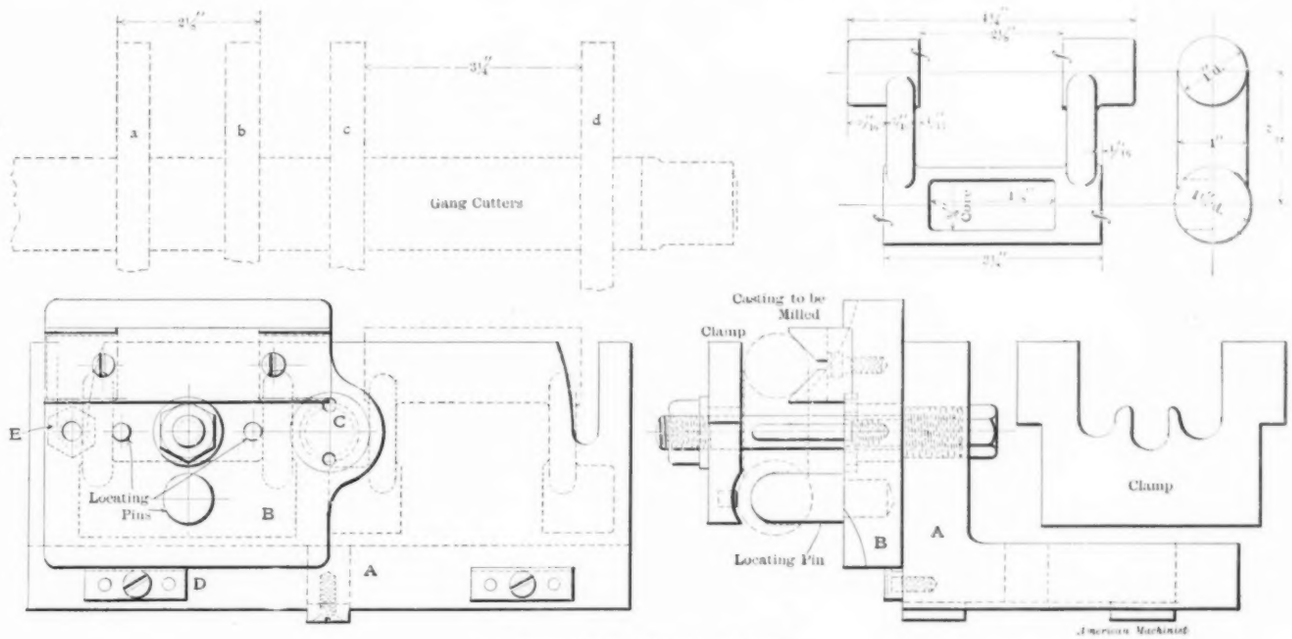
The cast-iron toggle shown in Fig. 1 required finishing on the inside surfaces of the top bosses and on the outer faces of the opposite end. It was desired to have these castings milled accurately and turned out rapidly, and this led to the designing of the fixture shown in Fig. 2.

The device consists of an angle piece *A*, with a cast-iron plate *B*, arranged to swing on a stud at *C*. In the front view the fixture is in position for the first cut to be made by the cutters *a* and *b*, shown above the fixture by dotted outline. The front piece *B* is located accurately by the stop piece *D* and clamped by the bolt *E*. Releasing the bolt while the work remains firmly clamped to the plate, and swinging to the opposite position for the second milling to be performed by the cutters *c* and *d* requires but a few seconds.

The cutters and fixture always remain in their relative positions and require no resetting after adjustment to the first piece machined. The cutters are so arranged in connection with the fixture that the alternate set while not cutting will clear all obstructions.

The method of locating and holding the work is shown by the end elevation sketch, and is so simple as to require no explanation.

D. E. MacCarthy.



A REVERSIBLE MILLING FIXTURE.

There is a good deal of activity in England at present in the installation of electric stations for supplying light and power to a district comprising several towns in a system which is obviously favored by the density of population. The most advanced of these plants is that of the Midland Electric Corporation, which will supply a district aggregating about 100 square miles in area. The region covered is a belt of the Black Country between Birmingham and Wolverhampton.

A Visit to the Works of the General Electric Company.

BY LYMAN B. THOMPSON.

It is almost impossible for one who has not visited them to realize the magnitude of these works or to conceive of the different varieties of work done.

Lying in the historic Mohawk Valley, between the Erie Canal and the tracks of the New York Central Railroad, in what was formerly the sleepy old Dutch town of Schenectady, but now a lively thriving city of 50,000 inhabitants, the plant consists of 319 acres of ground and 130 buildings, large and small, covering a ground space of 1,250,000 square feet, and a floor space of 1,500,000. Employment is given to more than 9,000 persons, male and female, and more than $125,000 are disbursed each week in wages.

For the welfare and comfort of such a large number of employees, there is a complete water system; the water for drinking being supplied to the buildings through the city mains from artesian wells, and it is pure and wholesome. For lavatory and other purposes water pumped from the Mohawk River and Erie Canal is used. The sewer system, put in and maintained by the company, is complete, there being more than three miles of mains and connections, with thirty-three catch-basins and thirty manholes. The lighting system is entirely electric, both arc and incandescent lamps being used. There are about 1,300 arc and 6,000 incandescent lamps, which is more than many first-class cities can boast, the city of Syracuse having only about 1,200 arcs.

Entering the gate-house and showing our credentials, we pass through and a broad macadamized avenue confronts us, having on either side a wide expanse of lawn, with shrubs and flowers, which are kept in the best condition by an experienced gardener and corps of assistants. Across the lawn on the right are a number of long, low buildings which are used for stabling a few horses and storing carriages and carts; but it may be well to state that all transportation of material, raw and finished, about the plant is done by means of flat cars drawn by motor cars operated by overhead trolley, and there are about 15 miles of railroad track, broad and narrow gage, extending to every building.

Directly in front of us is the new office building, which is a five-story and basement structure built in the form of a U, and every office is well lighted and ventilated. Each floor is divided by partitions into offices in which the different departments are located, the organization being such that the entire staff is divided under separate heads, each having its own duties.

To accommodate the force required to carry on the office work, about 700 desks are needed, and we can form an idea of the size of the building and the number of persons employed in it from this fact.

There are 1,260 outlets for electric lights in this building, the general illumination being by arc lamps, and in addition incandescent lamp desk fixtures are provided to be used if required. The trim throughout the entire building is of oak, antique finish, and is very handsome.

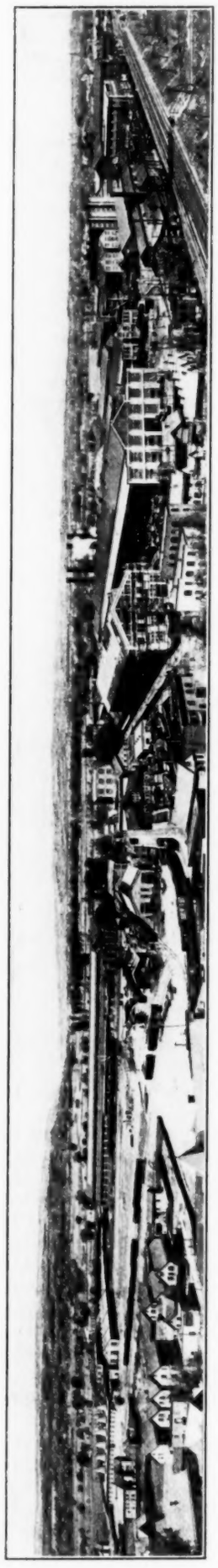


FIG. 1. GENERAL VIEW OF GENERAL ELECTRIC COMPANY'S WORKS.

The main entrance is spacious and four solid stone steps must be mounted before we enter the massive oak doors, then ten more and we are in the main hall. The main stairway is opposite the entrance and is of iron frame with stone steps. There are three flights of stairs to each floor and the tread and rise are easy.

On the left of the hall are two Otis elevators. We enter one of them and are quickly carried to the fifth floor, where we will begin our inspection, and work down. The engineers and draftsmen are on this floor, and, in connection with the annex building No. 4, about 400 persons are employed, producing an average of 125 drawings each day.*

The fourth floor is occupied by the foreign engineers, the railway, lighting, power and mining departments and publication bureau, and the third floor by the construction, supply and various other departments.

The rooms of the officers of the company are on the second floor, and there are other commodious rooms in which committees may meet to discuss important business details. The law department, where all legal matters are taken care of, and the accounting and auditing departments are also on this floor.

The office of the works is on the first floor, the manager and superintendents each having separate rooms; the purchasing, cost, production, pay and transportation divisions being on the same floor near at hand.

All the buildings and the separate departments in each are connected by a complete telephone system, and the "Central" is on this floor. There are about 350 stations, and the "hello girls" have as much business to attend to as in a city of a hundred thousand population.

The mailing department is in the basement, all letters and small packages being received from the floors above through mailing tubes. Near at hand is the cable and telegraph office, messages being received and sent directly.

The restaurant, now in building No. 8, will be in the basement, and complete arrangements are now being made for it.

There is a complete system of heating and ventilating, and here we see a number of blowers used to force hot or cold air through the ventilators into the various rooms, and they require motors of 50 horse-power to drive them.

As we come from the office building, we see the main street of the company stretching away in a straight line more than three-fourths of a mile, and on each side most of the buildings are situated, num-

*The view shown in Fig. 3 is of the old drawing office. The "U" shape of the new office building prevents any satisfactory view of the drawing office as a whole being made.

bered as in a city, odd numbers on the right, even on the left.*

Next the office building, on the left, is building No. 4, on the ground floor of which is the chemical laboratory, where samples of all raw materials received are tested for their adaptability to the work. The standardizing laboratory is also on this floor, and here all measuring instruments are standardized, and this department repairs and standardizes all the instruments used for tests throughout the works.

On the second floor is a laboratory for original research. Many interesting experiments are made here and great things are expected from it.

An annex of the engineers' department on the fifth floor of the office building occupies the third floor and the work here is largely for switchboards.

Buildings 4 and 6 are connected by a bridge, and, crossing this, we go in the blueprint room, where, if the sunlight fails, the printing is done by means of specially constructed electric lights. Girls to tabulate and boys to print are employed, and, when the needs of the shops demand it, produce 3,100 prints in one day, and in one year 30 miles of blueprint paper were used.

Leaving No. 6 we cross the street and enter No. 5, where the transformers are made. We see here machines so small that one could almost be carried in the vest pocket and others up to those weighing twenty-five tons. Round about us are great quantities of copper in various forms used in the manufacture of the transformers. We are told that during a period of one year at least 600,000 pounds of copper are used.

Coming out of No. 5 we enter No. 7, which is the next building on the same side of the street. This is the brass foundry, and is modern in all its appointments, having every facility for quick and economical production. Along the left side of the building are numbers of improved molding machines, and on the right the melting furnaces in which the different alloys are melted in crucibles. There are about forty of these furnaces and melts of 23,000 pounds have been made, producing castings weighing from 1 ounce to 800 pounds.

We cross the street to building No. 8 and are now in the restaurant, where anything from a cracker to a good substantial lunch at moderate cost can be secured, and frequently at the lunch hour 250 persons are served. All the cooking is done by electricity, and no dirt, dust or obnoxious smell is in evidence. Dish-washing and drying is also done automatically by electrically driven machines and all the appointments in the kitchen are wholesome, sweet and clean.

In the rear of the restaurant in the same building is a machine shop in which gear cases, bolts and screws are made. Here also is the headquarters of the steam, gas-fitting and plumbing department that looks after the proper installation and

FIG. 2. OFFICE BUILDING—NO. 23 AT THE LEFT, NO. 4 AT THE RIGHT.

*The view looking down this street is the most impressive of any about the works, but, although the attempt has been repeatedly made, no satisfactory photograph of it has been obtained. Fig. 1 is a view from a hillside and, while striking, is at the same time very inadequate—so much so, in fact, that we are seriously tempted to omit it. The company's street is at the farther end of buildings Nos. 16 and 20, and the buildings upon its opposite side are obscured by those on the near side. The railroad tracks in the foreground are those of the New York Central & Hudson River Railroad.—Ed.

maintenance of all sewer, water, gas and steam mains and branches in every part of the entire plant.

We now pass out of building No. 8 and enter No. 10, where the railway motors are made at the rate of 250 each week. We ask where do they all go to? and the answer is, to all parts of the world. Two hundred and fifty motors each week means 13,000 each year. The demand is constantly increasing and the floor space required to manufacture them is continually being augmented. The largest of these motors will develop 200 horse-power and weigh at least 5,500 pounds.

We pass out of No. 10, cross to the right of the company street and enter building No. 9. The smaller generators and motors are made here, the largest weighing 16 tons, generating 1,000 horse-power, and the machine tools in use are larger than we have yet seen.

Building No. 11 contains the testing department and we are confronted with electrical machinery of every description. Wires run in every conceivable direction; young men are bending over instruments on tables and others are signaling by holding up the hand or shouting, the whole forming a pantomime not understood to the uninitiated. Machines built in other departments are sent here to be tested in every practical way before being shipped. Young men who have graduated from an engineering school or college or who have had such practical experience in machine shop, repair shop or central power station as will enable them to do the work are eligible to this department, and are given a practical finish to their education and receive a training to fit them for advancement to the drafting-room, engineers' or commercial departments of the company. The young men receiving this training come from all parts of the world, and seventeen countries are represented at this time, including Jamaica, Scotland, England, Ireland, Italy, Sweden, Austria, Germany, Brazil, France, Russia, China, Japan, Australia, Mexico, Canada and our own country.

Galleries run around the sides and the rear end of the building. We go upstairs to the gallery on the right in which is the experimental department. Experimenting only is done here, though the place seems like any ordinary machine shop; so we pass on and watch the winding of spools and coils of different shapes for all the various motors, large and small. All the machinery here is specially designed for this particular work. About 2,000 spools are wound each week and the amount of insulated wire, tape, flat strips of copper, mica, oiled linen and fiber that enters into the construction of such a large number is almost beyond belief.

Between buildings 11 and 13 is a small structure known as 11B. This is the fire-house and the headquarters of all the night watchmen. It is well equipped with a steam fire engine, hose carriage, ladders and all necessary requirements to fight fire. There is a large steam pump in the building, which is used to force the water through the supply pipes, and pressure enough can be exerted to throw a stream 135 feet. In various accessible places on the property there are fire plugs and a number of small houses in which hose carriages are kept. In each of the buildings fire-alarm signal boxes are connected with alarm bells at designated stations, which in case of need, summon men who work in the shops and are trained to respond to such emergencies.

We now enter building No. 12, part of which is given up to testing, and all else we see is boxes, crates and bales piled one upon the other, tier upon tier, to the roof, a hight of 30 feet. This is the shipping department. Everything shipped from the works by freight or express passes through here; railroad cars are run into the building, loaded and sent to all parts of the country, to the Atlantic and Pacific coasts and then in steamers to all parts of the world. One hundred and eighty carloads, representing 4,320,000 pounds, are shipped each week, and the staff of men required to handle and record these shipments is necessarily large.

We cross the street again and enter the power station, building No. 13, from which is supplied all the power required by the plant itself as well as by the Schenectady street railway and the house and street lighting of the city. The power is supplied by three tandem compound engines and generators, generating 1,500 horse-power each, and one triple expansion engine and generator, generating 500 horse-power, which, with 1,000 horse-power transmitted from Mechanicsville, gives a total of 6,000

FIG. 3. DRAWING OFFICE.

horse-power. Our attention is attracted by numerous lights on a gallery. We see before us an immense switchboard extending the entire width of the building, a distance of about 80 feet, and the lights we saw are to illuminate the face of the indicating instruments that they may be easily read. Switches and instruments seem to be without number, but each and every one has its use and enables the men in charge to ascertain at any time the amount of power being used in each building, and, while the board may be a sealed book to the uninitiated, those in charge can read it as readily as we the newspaper.

Leaving the engine-room we pass into the boiler-room, and on each side are ranged eleven tubular boilers, or twenty-two in all. About 275 tons of coal are consumed every day, which is brought into the building in traveling buckets and served by Roney and American mechanical stokers.

Building No. 14 houses the wire and cable department, and the character of the work done here is so different from any we have yet seen that we are surprised. Directly in front of us, as we enter, is a carload of what seems to be, at first glance, large watermelons having a very dark rind; but of course they cannot be watermelons, and upon inquiry we learn that they are pure Para rubber in the crude state.

Continuing our walk, on the left we see machines winding wire and cable. A large open drum having a number of spindles on which spools of wire are fastened turns around a center wire and forms the wire or cable having a number of strands. If a larger cable is desired, this in turn becomes the center strand and a number of additional wires are wound on it. One particular machine attracts our attention and we find it is winding a small cable consisting of at least forty very fine strands. On the right we may see the process of covering the wire with the rubber. According to the diameter of the wire to be covered, rolls of rubber of the requisite width are placed in the machine and both wire and insulation are run through, forming rollers which turn the rubber over and around the wire, at the same time pressing the ends together and cutting off any surplus, leaving the covering perfectly neat and smooth.

Upstairs in the same building are hundreds of intricate machines winding, or more properly speaking, braiding cotton or silk insulation on wire; we are made dizzy by the constant peculiar movement of the spools, which dart in and out, in and out. When a machine is stopped by an attendant and the movement explained to us we cannot but admire the brain that devised it, so simple yet effective is it.

Passing into No. 22, which is in the rear of No. 14 and called the compound building, we further witness the manufacture of cable. Here are great vats of compound through which the cable is drawn, and a waterproof coating is the result. As a further protection, a covering of lead is often applied, and this is done by means of hydraulic pressure. Pig lead is melted in a furnace and allowed to flow into the cylinder of the press. The ram is then forced into the cylinder under a pressure of 200 tons, displacing the lead and forcing it through the dies, around the cable (which has previously been led into the press) and is thus smoothly covered and wound upon reels ready for shipment.

Passing on we enter building No. 15,

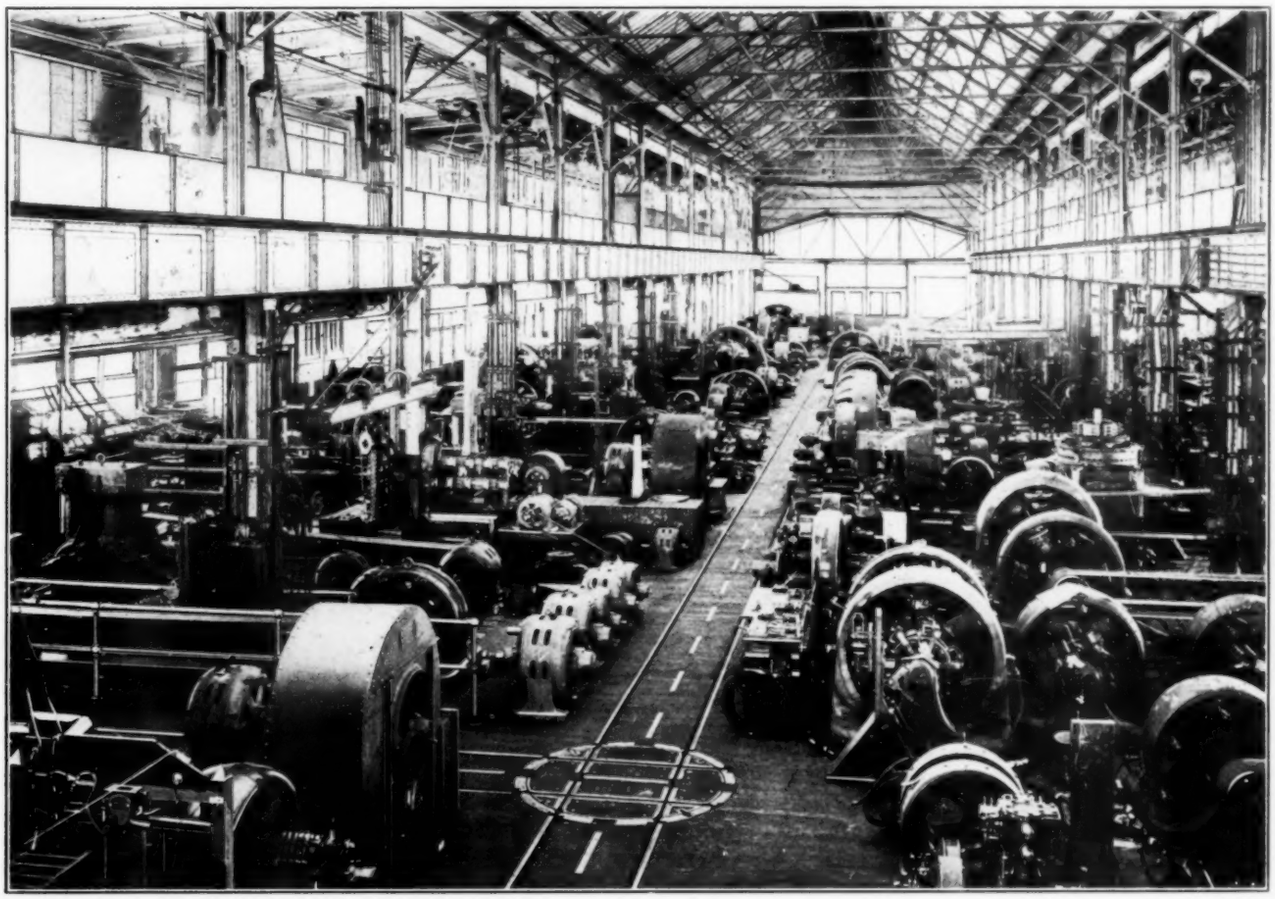


FIG. 4. INTERIOR OF NO. 11—TESTING DEPARTMENT.

where armatures are wound for all motors, large and small. We are impressed with the great number of employees. We see them working side by side, it seems to us, in a mass, and when we are told there are about a thousand hands we readily believe it. Copper, iron, steel, paper, cloth, mica, and many other materials enter into the construction of armatures, and machinery of special design necessary for the proper forwarding of the work is to be seen on every hand. About 400 armatures ranging from 1-30 of a horse-power to 10,000 are produced each week.

Recrossing the street we enter building No. 16 and are now under the roof of one of the largest ground floor machine

shops in the world. When we recover from our amazement at the unexpected vastness of the building and look around we are at once impressed with the neatness, order and cleanliness everywhere prevailing. The building is entirely fireproof, only iron, steel and brick entering into its construction. From the doorway in which we stand we look away to the opposite end, a sheer 850 feet, or one-sixth of a mile. The total width is 165 feet, the main or center bay being 65 feet in the clear; the distance from floor to ceiling being about 50 feet. The side bays are each 44 feet wide, the whole being thoroughly lighted and ventilated from side windows as well as skylights in the roof the entire length. On the right is a gallery 44 feet in width, extending the whole length of the building. In the center bay, 36 feet from the floor, are three motor-driven traveling cranes, two of 40 and one of 15 tons capacity. A crane of 50 tons capacity is also under construction and is soon to be installed. In the bay at the left are three motor-driven traveling cranes, one of 40 and two of 10 tons capacity, spanning 44 feet 8 inches, and scattered about in convenient places are numerous post cranes and lifts for light work.

At our left workmen are putting together armatures made up of laminated punchings, some of them so large that five and often six men are required walking round and round without cessation for a period of seventy hours.

Further along, in the center of the room, is an immense floor plate 40 feet wide and 350 feet long, made up of cast-iron sections set in the floor. On this the large pieces to be machined are placed and great portable machine tools, such as slotting, shaping, milling and drilling machines, all direct motor driven and capable of machining castings of unlimited size and weight, are lifted by the cranes and deposited where required. This department may be said to be the birthplace of the floor plate and portable machine tool system of handling heavy work.

We find still another large floor plate 20 feet wide and 200 feet long, on which the machines when finished are set while being tested. This part of the work is under the control of the testing department in building No. 11, and here, as in that building, wires are run in every direction, and we are confronted here and there with signs of warning, "Danger, 40,000 Volts."

Our attention is next attracted to a large excavation in the floor, and we learn it is the foundation and bed plate of what is to be the largest boring mill in the world. This machine was designed by the mechanical superintendent of the company and will bore and turn a piece 65 feet in diameter and be driven by a 50 horse-power motor.

Coming up the shop again, on the right, a portion of the floor is devoted to the manufacture of electric locomotives which are so largely used in mining operations, and destined in many instances to displace the steam locomotives on our railways.

Passing through a door at our left, we find ourselves in a large, clean, sanitary washroom, fitted up with individual lockers in which the workmen may hang their clothing and other belongings. In this building is the main tool stock-room of the works, and we are interested in the great number of gages of all diameters and length which are sent to all parts of the country that the dimensions of shafts for engines not built by the company may correspond in measurements with machines built by them. All the gages are carefully tested before sending away and when returned also.

Not only does this room contain tools for use in the works, but any workman in the employ of the company desiring to purchase a tool for his own use, may do so, securing it at cost price, and the weekly sales frequently aggregate $150. To sum up, in this building alone there are more than 300 various machine tools used in producing the work. About 80 of the machine tools are driven by direct-connected motors, all the portable and a great many of the stationary machine tools being so driven. The remainder of the machine tools are driven from a line shaft which is driven by direct-connected motor, there being about 150 motors in the building and about 1,100 employees.

FIG. 5. NATIONALITIES REPRESENTED ON THE TESTING DEPARTMENT STAFF.

In the west end of the gallery, brush holders are made, and in the east end hundreds of girls are employed splitting mica for use in the various machines.

We leave building No. 16 and cross the street to No. 17, which contains the armature disk department. Here were see sev-

enty power punch presses standing in two long rows down each side of the room and most of them are operated day and night. The laminations are made from sheet steel which is received in long lengths. Punchings of various designs required are made from these and more than 1,300 tons of disks are produced each month. After the disk are finished, they are put into steel boxes or cars and run into furnaces to be annealed. The cars run on balls which run in grooves leading into the furnace. After annealing the disks are more or less crooked and require straightening, which is done by running them through rolls, when they are now ready for varnishing. Formerly this was done by hand and required a great length of time and much room for storage while drying, but now the work is done by machines of special design as fast as a man can feed them into it, and when they come out of the machine they are thoroughly dry and ready for use.

There are two galleries in the building, that on the left being a tool department devoted to the manufacture and repair of the punches and dies required to keep so many presses supplied. Among the special tools to be seen here are radius planing and grinding machines with open side, on which large curved dies which are too large to be turned are planed and ground. The gallery on the right is where the coils for the various armatures are formed, the machines and tools being specially designed for the work required. We are particularly interested in several machines which wind coils from flat band copper, the strips being wound edgewise over round and oblong forms and without bending or buckling.

Building No. 18 contains the blacksmith shop, which is well lighted and ventilated. There are about thirty fires, each well protected by an exhaust hood to carry off the smoke.

Leaving the forge we cross into building No. 20, devoted to building engines for marine use, which are directly connected to the armature shaft, the work done here being largely for the government. The need of space in which to do the work now done in this building has increased to such an extent that a new fireproof structure, which will be 810 feet long and 100 feet wide, is now being erected to cover the space now occupied by No. 20, and when completed old No. 20 will be pulled down, but without interruption to the work.

We are now at Mill Lane, a public street running through the property of the company. We cross and enter building 74, which contains the carpenter, cabinet and printing departments. The first floor is largely given up to making packing boxes, in which the machinery to be shipped is packed, and a large force of men is needed to keep up with the demand. Here we see boxes made by machinery which is so constructed that boards which have previously been sawed into proper lengths are placed under them and, at one blow, nails drop in the proper places and are forced into the wood. There being so many buildings, some of them are constantly needing repairs and alterations, and here also is the headquarters of a great number of workmen necessary to do the work about the plant.

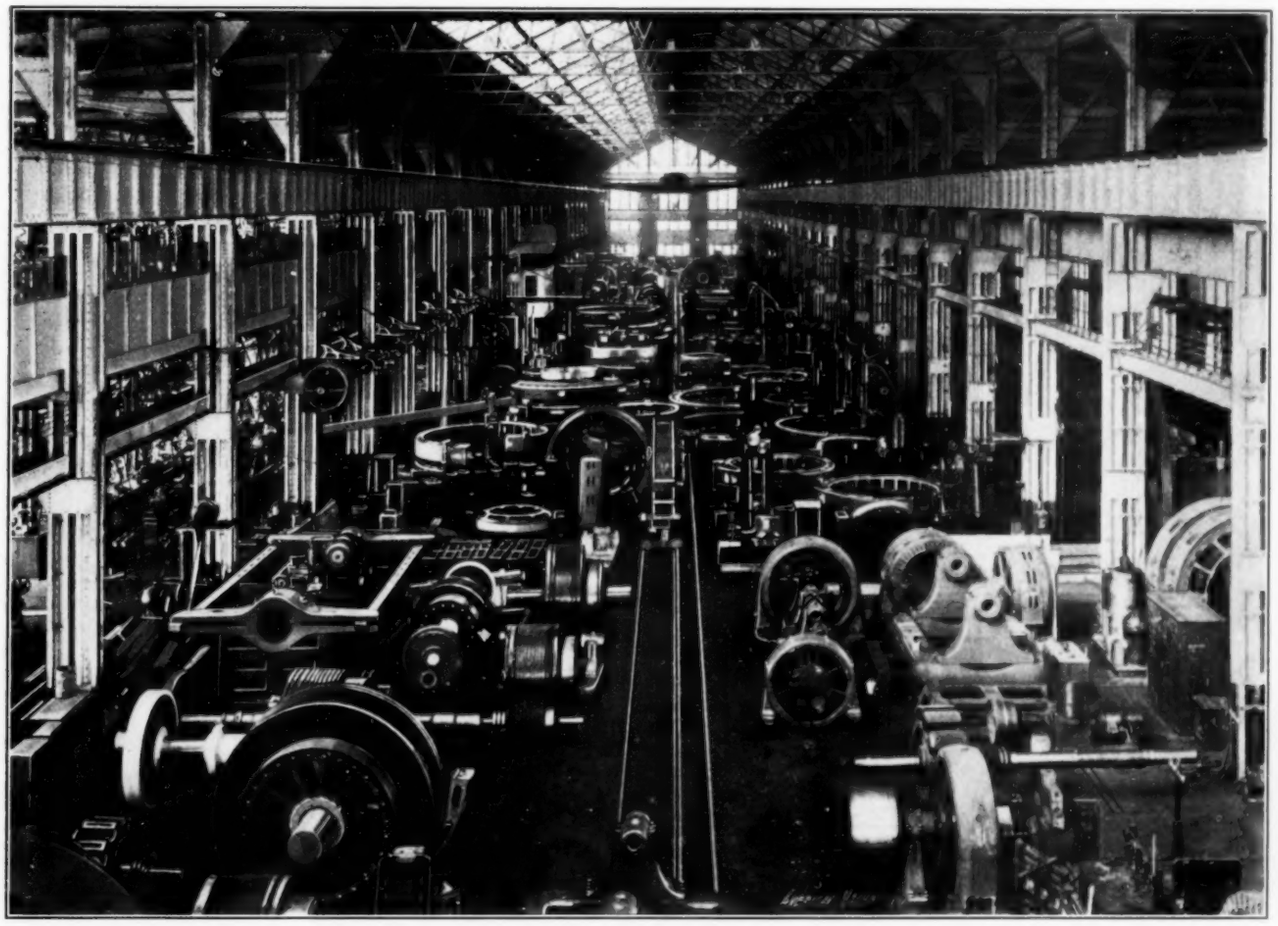


FIG. 6. INTERIOR OF NO. 16—THE GREAT MACHINE SHOP.

Upstairs is the shop where the cabinet work is done and many beautiful pieces of wood work for use on the various electrical apparatus are seen.

In the rear of the carpenter shop is a completely equipped printing establishment employing about eighty-five hands, producing four tons of printed matter each week, three tons being used in this plant and the remainder being sent away. All records, pads, order blanks, letter heads, etc., required in the works and offices are made here and all publications and printed matter of whatever nature required by the general office and the branch offices in

other cities. There are eight flat-bed steam printing presses and as many more foot presses constantly in operation. Upstairs the type-setting is done by hand and machine, and on this floor also the binding of pamphlets and books is done in an artistic manner.

Building No. 77 is a three-story brick structure containing the pattern department. A portion of the ground floor is given up to the making of metal patterns, which we are informed are being more and more used, especially in duplicate work. Part of the first and all of the second and third floors are given up to the making of wood patterns.

Leaving here and coming back to the street, on our right we see the iron foundry, known as building No. 83, and which is one of the largest gray iron foundries in the world. As with No. 16, we are impressed with the bigness of this building. As we enter we come first to the cleaning room. Pneumatic chipping hammers are used very extensively, and above the din of other machinery we hear the constant roll as they do their work. On the left a number of rumbles are seen in which the small castings are cleaned. Passing into the foundry proper we see it is a very large building having a wide center bay and a smaller one on each side. There are three traveling cranes now in the large bay, a new one in course of construction and seven smaller cranes in the side bays, making eleven cranes in all, beside innumerable post cranes and electric and pneumatic hoists in convenient places.

The floor of the large bay is wholly given up to the molding of large castings, some of them weighing more than 20 tons. In the small bay on the left the smaller floor and bench work is done. In the bay on the right there are about forty of the latest improved molding machines, standing in long, straight rows, on which moldings for castings large and small are made almost while we say "Jack Robinson." About the center of the floor are four cupolas. The core-making department is in this bay also, and including all branches there are more than 800 men employed and about 115 tons of castings are produced every day.

As we come out of the foundry we see several large buildings about a quarter of a mile in the distance, of which the first on our right is No. 91, and here we see all the process of oiling or varnishing linen. A roll of linen is put in place and led over rollers into a vessel containing the varnish and led up over other rollers about 10 feet from the floor through a box which contains steam pipes. While the linen is making the journey up and down it is drying, and when it emerges is thoroughly dry and ready for use. The movement of the machines is extremely slow, but nevertheless produce 10 yards of oiled linen per hour.

FIG. 7. INTERIOR OF NO. 83—THE FOUNDRY.

Crossing the street we enter building No. 82, a very large brick building used for storage of patterns. They tell us it contains hundreds of thousands of patterns (no one knows just how many) representing more than a million dollars in value.

In the rear of No. 82 is No. 90, called the "scrap building," and here we see many curious old electrical machines, some of them the first of their kind and obsolete. The company do not believe in holding a machine tool when something better can be had, and machine tools that have been superseded are sent to scrap to be sold or otherwise disposed of.

Across the street, in building No. 92, the articles of rubber are manufactured of all forms and sizes.

The manufacture of porcelain articles is done in building No. 94, and much the same process of molding is used as in No. 92. The presses, however, are operated by hand and foot power instead of hydraulic.

As we enter, on our left are several

large vaults in which are stored China clay, flint, "ball and spar," and near them machines which are pulverizing the clays for use in the molds. When the molds are taken from the presses they are placed on long boards and these boards laid on racks until thoroughly dry. When dry they are trimmed of all surplus clay the die may have left and then fired in kilns for a period of forty hours. There are six of these kilns, and the pieces to be fired are put carefully into receptacles and these in turn packed in the kilns; the door of the oven is then securely closed when the fires are started and allowed to burn until the end of the period.

Coming up the street again and passing in the rear of building No. 16, we cross the railroad tracks and enter building No. 29, which is the tube department, where tubes for underground conduit work are made. Lying stacked in piles are hundreds of tubes each 20 feet long, used for the three-wire system. Three copper rods, each separately wound about with a jute covering, to prevent contact with each other, and the whole then rewound with the same material prevents contact with the interior of the tube and keeps the rods in the center. The cable is drawn through the tube and hot asphalt is forced into it, which fills every space in the tube and protects the cable from injury while in the ground. In one portion of the building is a complete outfit for manufacturing insulating compound used in the various departments.

The next place we visit is the receiving and stock room in building No. 27. Everything of whatever nature coming into the works is first sent to this building and then distributed to the various departments. About sixty carloads of material are received each day, the freight on which amounts to a small fortune each week. Here we see great stacks of copper, iron and steel in various forms, fiber, thousands of bolts, nuts and screws, bales of yarn and cotton, and a hundred and one other articles.

Leaving No. 27 we enter building No. 73, which, though small, is interesting. This is where the stationery is kept, and all the supplies of this kind for the various works of the company, the general and branch offices, are distributed from here, and as an illustration of the immense quantities of material of this nature used we are told that more than 1,500 gross of pen are used in one year and other things in like proportion.

The photographic studio is in this building. We enter and a complete outfit of a well-equipped place confronts us. Thousands of negatives are stored here and often referred to.

Crossing the yard we enter building No. 26, which is a three-story brick building in the form of a U. On the right is the toolmaking room of the punching and forming department. Dies and punches necessary for this department only are made here, and a large force of the most skilled mechanics are employed to supply the demand for new work and repairs required for about eighty presses.

The toolroom occupies only a section of one side of the U, the other section and end being filled with the machines which are set in long rows with ample working space between. Here are punching and formed articles of brass, copper, steel and iron for use in the manufacture of sockets, switches, etc.

We now enter the left side of the U and see a number of turret lathes and automatic machines at work. Separated by a partition from the lathes is the grinding, polishing and buffing room. As we look down the room it would seem there is no end to the long row of machines and out of curiosity we count them and find there are seventy-five wheels in operation.

The entire second floor is given up to the manufacture of rheostats used for starting motors, etc. On our left is a room in which every rheostat is thoroughly tested and tried before being sent out of the factory.

On the third floor, lamp bases, sockets, cut-outs, switches and small articles of like nature are made, and because of the smallness of the work most of the employees are girls and women.

We now go into building No. 25, which is called the dipping department, and we see large tanks of prepared solution into which the different metals are dipped for the purpose of cleaning and restoring the natural color. Here, too, is a room in which the parts of the various machines requiring it are japanned.

We have at last got to the point from which we began and are now at building No. 23, which we were to enter on our way back. It also is a three-story brick building having three wings in the form of a T, and it probably contains more square feet of floor space than any other one building on the premises. On the first floor, in the south wing, the railway motor controllers of all designs are assembled. The north wing of this floor is used for the assembling of switch-boards. The boards are made of polished marble or slate panels and we see them in all stages of construction. We read the tags on the finished boards and find they are for customers in all parts of our own country and for shipment to Japan, India, Trinidad, South Africa and many other foreign countries. The east wing of the same floor is the screw department, and here we see automatic machines, which, with the many hand machines, finish immense numbers of small screws, bolts, nuts, etc., required in the works.

The second floor, over the screw department, is a toolroom in which the different machine tools are repaired and the special machine tools we have seen in the several departments are made from designs of the company's engineers. Passing into the north wing on this floor we see the manufacture of the parts required for switch-boards, and in the south wing the parts for controllers are made.

On the third floor of this wing searchlight projectors, now so familiar to most of us, are made, and if it were our privilege to be here in the evening we would witness many interesting tests, as from the tower of the building the powerful beams of light are flashed over the valley and city.

A Lesson in Business Correspondence.

The following correspondence, originally published in the *St. Louis Lumberman*, we take pleasure in bringing to the attention of our readers. We cut out some unnecessary explanations and we can well trust the letters to enforce their own lesson. We admire the manly persistence of the belt maker. The letters are as follows:

TO THE BELT MAKER.

"We have sent you under separate cover two pieces of belting of which I bought one roll of you a short time ago. A day or two since we opened the roll and used about 30 feet of it on a flooring machine. It made about five revolutions and the belt broke, as you can see by sample we sent you. The writer is satisfied in his own mind that it is an inferior quality of belt, and we should like to return it. We will pay the freight both ways, pay for what we have used of it, and you refund us the money for the balance, and we will allow you in addition 5 cents per foot."

FROM THE BELT MAKER.

"Your letter of May 15 fell upon us like a thunderbolt from a clear sky. Since, however, we got the sample of leather which you returned to us we feel very much relieved. This shows very clearly that in some manner the belt met with an accident, when either it or the machinery had to break. Our salesman will be over to see you in a few days. We trust you will not condemn our belt on any such grounds as this. Put the belt together again on the machine and run it. If it does not (barring accidents) give as good or better service than any belt you ever had, we will not only take it back, but give you the full amount you paid for it, and not cause you to lose 5 cents per foot, as suggested. We unhesitatingly claim that a better piece of leather than the sample you sent to us is not to be found, and are willing to submit it to any of our competitors. These goods are made from the very best slow-process oak-tanned leather, and the piece that you have returned to us is cut from a point within a half inch of the backbone of the hide. We are satisfied that, while the first piece has apparently been unsatisfactory, after you have used two or three belts off the roll you will very promptly change your mind."

TO THE BELT MAKER.

"In reply, will say that it is not necessary for you to send your salesman over here, for you say that the leather is of the very best manufactured. His coming here

would not change the facts in the case. We believe, and in fact we know from experience, that the belting is no good. We have tried another piece, and it simply goes to pieces in less than twenty minutes. The belting is paid for, and that ends our business relations."

FROM THE BELT MAKER.

"We acknowledge receipt of a letter dated May 23, signed by yourself as president. Assuming that you are a fair-minded man, we ask you to look it over and see if your position is tenable. You have no doubt used a great deal of leather belting, and know that even the poorest quality would run more than twenty minutes. We have taken the piece returned to us, cut a section one inch wide and delivered to a wire-rope company who have a very fine machine for testing tensile strength, and submit to you a copy of the cerificate, which we feel should have some weight. You may not be aware of the fact, but it is nevertheless true, that when a belt delivering power is subjected to strain (even with tighteners) greater than 60 to 100 pounds to the square inch, cross section, it will slip on the pulleys; therefore, this piece of leather, by breaking, demonstarted that it must have received a strain which it could not get in the severest work, when properly used. We had the test made by disinterested parties. The gentleman who made the test tells us that he has tested many samples of different brands of belting, but never had a piece that stood so great a strain as this. We are aware that our salesman coming over to see you will 'not alter the facts'; we wish him to get them. This matter is more important to us than you seem to think. If we make belting that is 'no good' we do not wish it to get in the hands of our customers. We feel we are entitled to fair and just treatment in this matter, and appeal to you personally to see that we get it. The fact that the belting is paid for will not end this matter; we propose to give you as fine a piece of belting as you ever used. If a man bought lumber from you and would claim it was 'no good,' would you not feel just as we do? We have made considerable belting. Should your roll prove to be worthless, as claimed, it will be the first of the kind that ever went out of our factory. We want only fair play between man and man."

WHERE THE TROUBLE WAS.

The belt manufacturer sent his salesman to call on the mill man. He was told to go into the mill and see the foreman. The latter told the salesman that the belt was all right; the only trouble was that they had always used belt that would stretch more or less, and had cut this particular piece too short. When they attempted to run it on the pulleys it tore in two. They spliced a piece in, and then it ran as well as any belt they ever had. The salesman went into the office and told the proprietor what the foreman had said. He seemed very much astonished and asked the salesman to "just sit down here a few minutes." He went out and found what the salesman said was true. The man who put the belts on did not wish to admit he was at fault, so had reported the belts "no good." The proprietor then came into the office and said to the salesman: "Tell your house I did not investigate as I should have done before, and am very sorry I made the complaint." To show his good-will he gave the salesman another order.

Notes by a Wandering Mechanic.

SOME SHOP SYSTEMS—STOCK ROOMS—SUPPORT FOR MOTOR—CENTER FINDERS—INDEXING JIG—CIRCULAR PLANING ATTACHMENT—TOOL FOR BORING TAPER HOLES—FIXTURE FOR TESTING BEVEL GEARS—ATTACHMENT FOR FACING OFF DRILL PRESS COLUMNS.

BY H. GOLDSMITH.

At my boarding place in Philadelphia I had a room adjoining one occupied by a B. & O. Railroad inspector, who was inspecting some engines that were being built by the Baldwin Locomotive Works, and through his courtesy I got into the Baldwin shops. These are so extensive that to simply go through them slowly, taking in each floor of their many buildings, would require over three hours of steady walking.

The different departments are operated independently of each other, the work being divided among contractors who are subject to orders from a general foreman, and he in turn under orders from a general superintendent and an assistant superintendent. Each department has the machines best suited to handling its work, and specially arranged tools are in evidence everywhere. Take, for instance, the Vauclain type of compound engine with high and low pressure cylinders and cylindrical steam-chest; you will find at least five special machines designed for boring the three holes at once and taking a finishing cut through them at the rate of 1-inch feed per turn of bar. These large machines are placed in a room with a ceiling not over 12 feet high, and to handle the very heavy castings a jib crane is used with a track attached to the floor and one

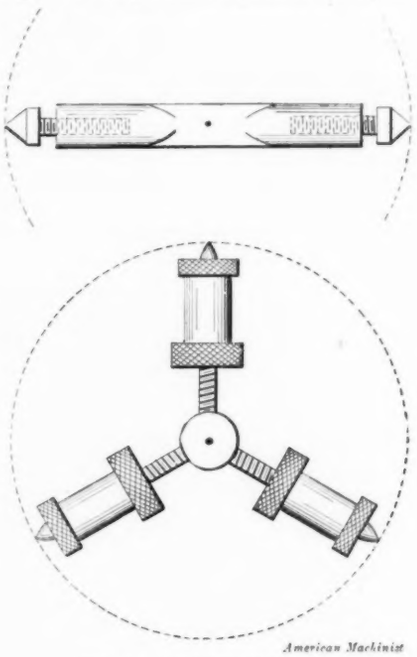


FIG. 24. CENTER FINDERS.

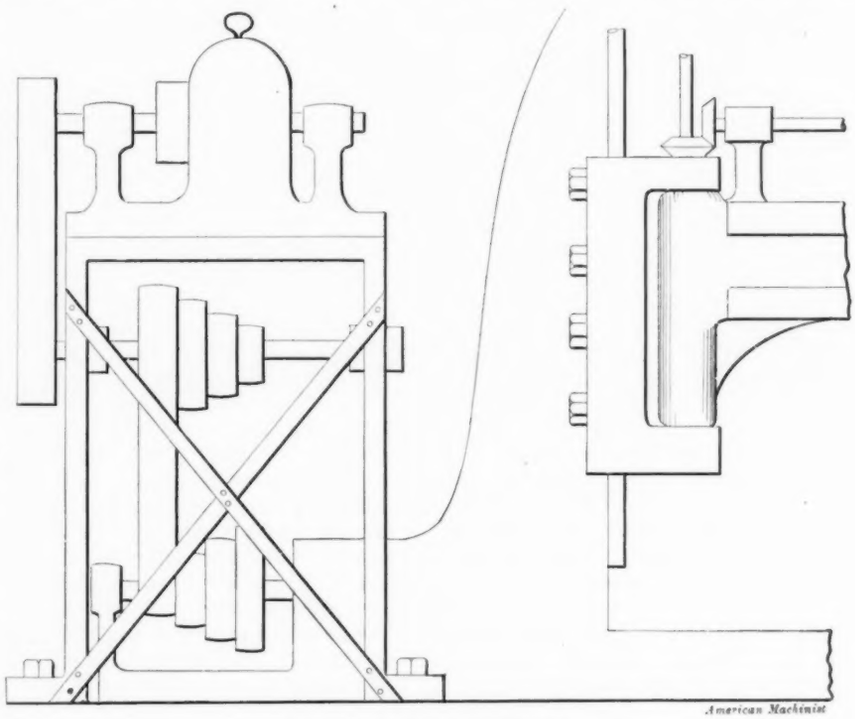


FIG. 23. SUPPORT FOR MOTOR.

to the ceiling. All movements of this crane, such as rotating, traversing, raising and lowering of the load are controlled by the operator, who is in a little car attached to the crane, with the electrical controllers near at hand.

The stock-room for bar steel and iron is arranged on the pigeon-hole order. The various grades of steel and iron are assigned certain colors and the ends of the bars painted accordingly. For example, a bar of tool steel may be painted blue and machinery steel red, etc.; in this manner the stock-keeper becomes familiar with the different kinds of steel or iron and is able to pick out what is wanted at once.

It was decided at the Baldwin shops, after experimenting, that individual drives for some of their machines would be profitable, and the support shown in Fig. 23 was designed for carrying the motor and driving cone. This made a simple and satisfactory arrangement and left a clear overhead passageway for the cranes.

There are in these works electrically driven cranes that are large enough to pick up (and they do pick up) the heaviest locomotive built, raise it over the top of the ones building, carry it the full length of the shop and put it down without disturbing the smallest pin.

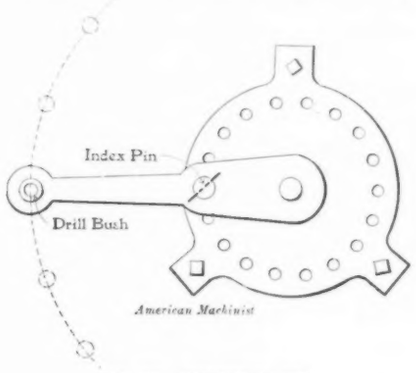


FIG. 25. INDEXING JIG.

Fig. 24 shows two handy tools used there for locating the centers in large holes. Fig. 25 shows a drill jig for large circular work, and Fig. 26 shows a circular planing attachment which can be adjusted to suit different jobs.

The above shops completed my Philadelphia plans, and the next stop on the program was Wilmington, Del., where I landed about September 3 and got a job with the American Turret Lathe Company as a layer-out on the surface plate. One of the interesting tools I ran across there was a boring device, shown in Fig. 27. This was used in boring the taper holes for their spindle bearings.

After visiting the Betts machine shops, which are well up to date in modern machine tools, I was ready to be off to other fields nearer New York city. So, giving my customary week's notice, I bid farewell to Wilmington, after a three weeks' sojourn in the City by the Creek, and purchased a ticket for Newark, N. J. Landing in that city September 26 at noon, I immediately started out to hunt a job. After being told a few times at various shops where I applied that they had enough men, I at last succeeded in persuading the superintendent of the Newark Machine Tool Company (Binsse Machine Company) that I was just the fellow he was looking for as a toolmaker and received an invitation —which I accepted—to start work the next morning at 7 o'clock. Skirmishing about for a boarding-house was the next thing, and a suitable one was found before 6 P. M.; then came the hauling of the trunk from the depot and the unpacking so as to be ready for the next day. You can all say what you like, but I feel sorry for the traveling salesman with a few trunks to pack and unpack every twenty-four hours. Once every three or four weeks was enough for me.

The shops of the Binsse Machine Company are located in that part of New Jersey called Harrison—right across the river from Newark and in the lowlands, or the lands in which the famous "Jersey skeeters" are born and raised and never to be forgotten after once being introduced.

The company make a specialty of horizontal drilling and boring machines. At their place I saw, among other things, the fixture—shown in Fig. 28—for testing bevel gears. It has, as will be noticed, vertical and horizontal adjustments and can be set for the various sizes of gears. They had a good system in their tool-room for caring for drills and taps. Suppose you wanted to drill and tap a 5/8-inch hole; calling for this size tap you are handed a tap size drill, clearance drill, taper, plug and bottoming tap and a tap wrench all in one box. The same system applied to reamers, you receive a drill, solid reamer and adjustable hand reamer all in one box. With this arrangement all holes are bound to be drilled, tapped or reamed to the correct size and no time is lost in looking up the proper size drills.

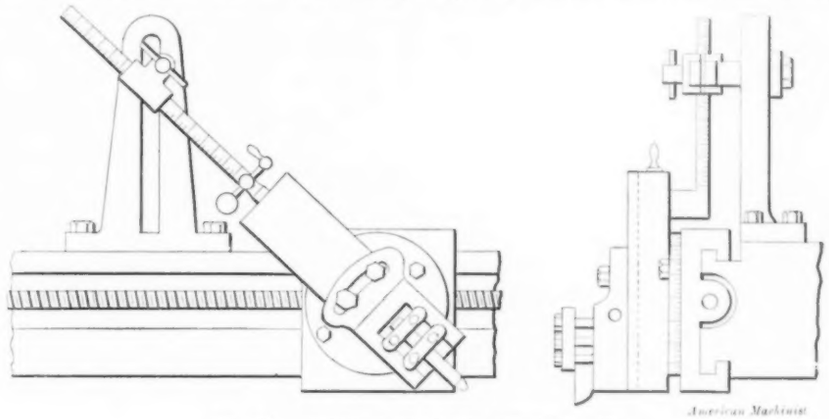


FIG. 26. CIRCULAR PLANING ATTACHMENT.

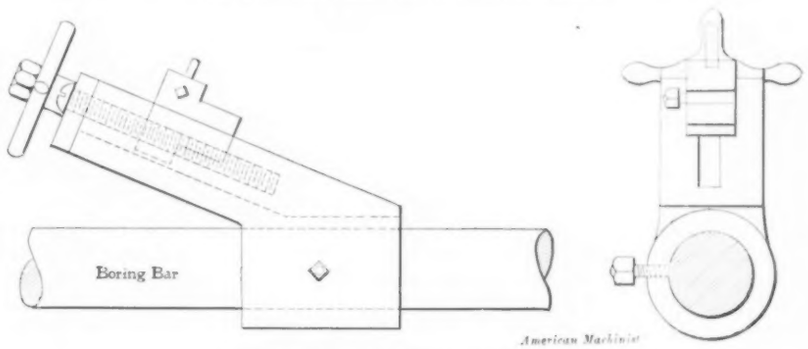


FIG. 27. TOOL FOR BORING TAPER HOLES

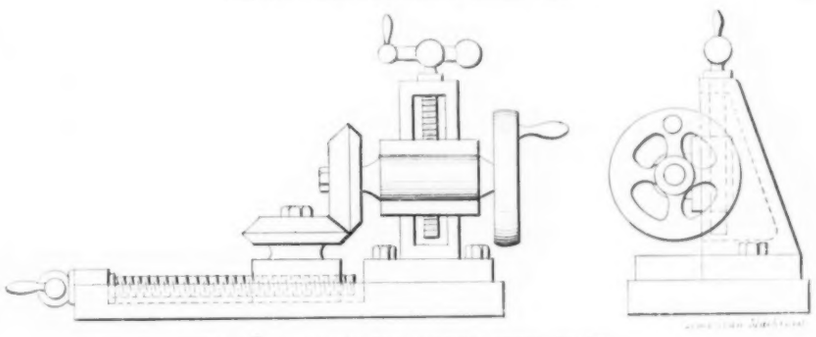


FIG. 28. FIXTURE FOR TESTING BEVEL GEARS.

Fig. 29 shows an attachment for a lathe footstock, seen at the Gould & Eberhardt shops at Newark. With this attachment the end of a drill press column is faced off while the column is being turned.

The latter part of October I took a trip to Plainfield and received permission to go through the shops of the Pond Machine Tool Company. There all stock is cut off, centered, weighed and placed in bins, numbered to correspond to cut-off lists. One man does nothing but look after this work.

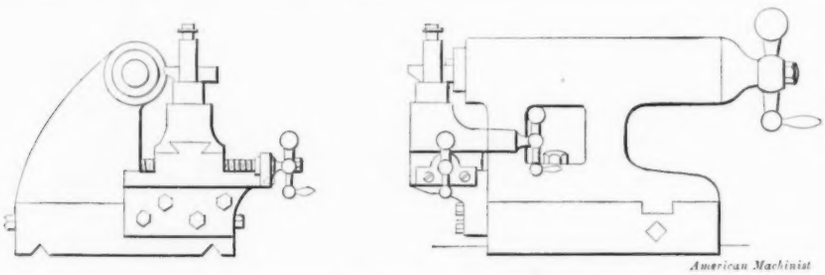


FIG. 29. ATTACHMENT FOR FACING OFF DRILL PRESS COLUMNS.

All headstocks, tailstocks, carriages, aprons, compound rests, etc., are finished complete and sent to a stock-room in lots of twelve and held until the order for a certain length of bed is issued, then the parts are brought from the stock-room and assembled on the proper bed, the lead screw being made to suit. With this system all confusion is avoided.

The Search for Work.

The reasons for seeking new situations are many and various. There are, and always will be, some unemployed involuntarily, and others, more fortunate in maintaining their positions, but scarcely less eager in looking up jobs.

It should not be a difficult matter for an enterprising man to obtain employment at any time, and particularly at such times as the present. It is for those who seek that these remarks are intended.

The old-fashioned method of seeking employment by a personally conducted shop-to-shop tour is seldom used now, except by the lower grades of labor. The difficulty of "seeing the boss," the curt reply of the clerk or the impudence of the average office boy are alike discouraging. The personal affronts, tiresome tramps and weary waits are relegated largely to the past, and more business-like methods prevail; methods cheaper, equally effective and far more satisfactory to all concerned.

Much of the same course is necessary in answering advertisements as in making an unauthorized, or general, personal application. It is a noticeable fact that less than one-fourth of "Help Wanted" advertisements give addresses that indicate their whereabouts; something like 2 per cent. only extend an invitation to call. The reasons are obvious. In some cases the offices would swarm with applicants, obstructing business and wasting time unnecessarily, besides which the man who does the hiring commonly has many other important duties to perform, from the midst of which it is vexatious to be called away to spend time in gathering from an applicant such statements as are considered desirable to obtain from an employee, and which could be briefly but clearly indicated in a note—valuable in itself for future reference—and which should contain a polite request that it be laid on the desk of the foreman in charge. Then at a convenient time he can take the matter up and be able to more fully consider it and be likely to view the application far more favorably than if hurried.

A personal interview is desirable, even necessary, but not at this stage. The mails, telegraph or 'phone are rapid in operation, and employers do not hesitate to make use of them in making appointments with presumably desirable prospective employees. Hence in the beginning it is well to lay in a stock of stationery, patience, perseverance and prudence.

Experienced men will keep clear of an employment agency. There may be some that serve the purpose their name would indicate; but there are others, and the others are in the majority. Those who value their time and money will have nothing to do with concerns which expect a small deposit or pecuniary assistance in any way in connection with employment. It means loss invariably.

Advertisements under the head "Situations Wanted" in the dailies seldom effect their objects. Employers do not buy newspapers for that purpose; if they want a man *they* are the ones who advertise and make their wants known. Advertising in trade journals of established reputation is a quite different proposition; but, after all, answering advertisements is the common course of getting new positions, the most prolific of results, and in the shortest possible time.

What to say in a letter making application for employment depends somewhat on the advertisement, if the cue was so obtained, more on the character of the position and most on the personality of the writer. No two will be quit alike, and no specific rule can be given, although a certain set of facts are always expected to be stated.

Some things may well be avoided. For instance, if you get kicked out, figuratively speaking, from some past situation there is no sense in trying to explain it, or even mentioning it, if it can be avoided without violating the truth.

No person with well-rounded common sense will expect you to state what wages or salary you got at such and such a place; neither would you care to give such information unless the wages were high, or what your reasons are for making a change, or why you made changes in the past. These matters are your own private concerns, and it is manifestly absurd to expect a man to give testimony which might be detrimental to his interests, or be likely to provoke a suspicion of "faking."

If you have been a "rolling stone," don't mention it, for it is considered so generally that the rolling stone gathers no moss. This may be true enough, but carry the analogy further, and it will be granted that *no* stone rolls forever; that at some place in its path it will find a suitable crevice, in which it will fit with ease to itself and benefit to the hole, helping to smooth and level the face of the universe. So it may be with human nature; some people may lack appreciation of and pass after trial many positions, seeking intuitively for something approximating the ideal they have set up for themselves, until they finally meet with it. There are possibilities that their aim and ambition are beyond their caliber, but the chances are that they will at some time recognize this and content themselves as near the mark as possible. Perhaps this is the place you will want to remain in, and in which you will fill a "long-felt want"; therefore don't prejudice the negotiator; on the other hand, if you have been in one shop twenty years, at the same old job, it may not be regarded as altogether creditable to you either, and if you are looking for a change to something different, you will scarcely be preferred.

Don't be too modest in stating your capabilities and knowledge; you are dealing with strangers who presumably want a good man; if you haven't an abiding faith in your own ability, you can't expect others to have it; this is the time for you to put out your best efforts in self-appreciation. But be prudent; don' overdo it. Let your experience show what you have done and your references back up your statements.

The ordinary questions you know; when and where you were born, married or single, wages wanted, or salary expected, particulars of experience, references, address, etc. If you have valuable letters of reference, never send the originals, copies will answer equally well. A full address should be given, for mail, message and 'phone if possible; enclose a self-addressed stamped envelope, indicating that you expect a reply.* Neatness, legibility, spelling and composition all play a part, although un-

*We doubt the advisability of enclosing stamped envelopes or stamps in letters of this character.—Ed.

consciously it may be, in making a selection, but dependence must be mainly on the force expressed in the applicant's individuality and his experience. When you get summoned to an interview, don't dress like a dandy or a tramp if you can help it; be clean, anyway. Don't go into a business office with a foul cigar or a fouler cigarette; smoke afterwards if you must and likewise let onions and liquors alone, if you really want a job, until after you have gotten it, anyway. Be prudent in what you say; let the other fellow do the talking, largely, but by this it is not meant to act like a dummy.

Then, too, after you have the job, remember that the boss's eye will seek you out very frequently for some time to come, and that in the corner of his desk he has several other applications; therefore it won't do to let up doing your level best; it never does pay, for that matter, at any time, whether in the search for work or in holding a position after it is attained.

W.

Letters From Practical Men.

A Wonderful Piston-Rod Break and Quick Repair.

Editor American Machinist:

The piston was that of a 12x20-inch steam engine. We had lots of work on hand and most of it was wanted in a hurry. Every man was doing his best, when one day suddenly a sharp snap was heard from the direction of the engine, followed by several hard knocks and then a quick shutdown. When we got the cylinder head off we saw what seemed almost a miracle. The piston rod had broken at *A*, leaving the two nuts in the recess of the cylinder head. It seemed as if nothing short of a miracle could have prevented those nuts from falling between the piston and head.

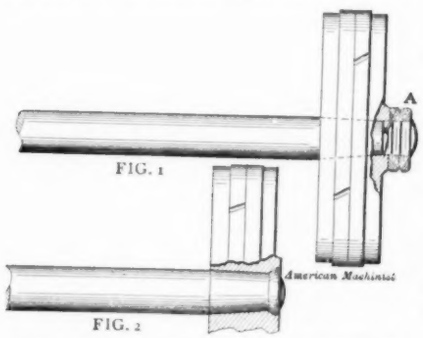


FIG. 1

FIG. 2

HOW THE ROD BROKE AND WAS REPAIRED.

To all of us it appeared like a shutdown. The foreman came up and looked at the break, and he said: "Pull out that piston and rod, boys. We'll have her going in a few minutes."

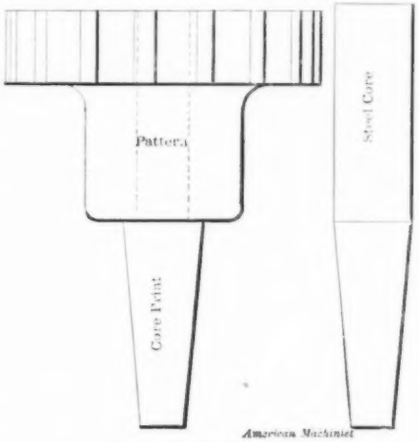
When we had the parts where he could handle them he took a cold chisel and hammer and cut the countersink *C*, then placing a pig of babbitt on an anvil, to protect the thread on the other end of the rod, he riveted it into place, making a very neat repair, as shown by Fig. 2.

J. N. GERMAIN.

Micrometric Precision in Iron Casting.

Editor American Machinist:

A problem which frequently comes up among the builders of a certain class of machinery which requires no great accuracy or finish, and which embraces nearly all the line of manufacture designated as "hardware specialties," is how to produce holes which are "good enough," and no better, in the least expensive way. Recently I have been confronted with this proposition in a way which allowed no in-



STEEL CORE PRACTICE.

decision, and, as my solution of it in our work has given decided satisfaction to all parties interested, I believe it may be of sufficient interest to your readers to warrant its publication.

The use of cast-iron cores, or "chills," is very old, and the results obtained are inaccurate and prevent any machine operations afterward, owing to the chill. The use of steel cores, coated with a preparation which is so perfect a non-conductor of heat as to prevent chilling, is not new, and yet it is so little known that a record of our experiments may prove of value.

In this line of our manufacture, we use cast gears of diameters varying from 1 to 12 inches, and with holes ranging from ⅜ to 1 inch. We made for each size of gear a set of six steel cores, varying from each other in diameter by .002 inch, and from .006 inch below to .006 inch above standard size, to ascertain the shrinkage and the allowance necessary.

The results show that on holes having diameters of not over 1 inch we may depend upon a casting having a hole varying in diameter from .001 to .0015 inch larger than the steel core used. The gears that we obtain by this method vary so slightly that we find they can be cast as desired, in either loose or driving fits, for cold rolled shafts with safety. The holes, if anything, are softer than the surface in contact with the sand, and we drill small pin-holes, mill, ream, scrape, or keyseat them with no inconvenience.

The holes are perfectly straight and smoother than we would expect, while in instances where we wish even greater accuracy we are casting them about .008 inch small and reaming with ordinary fluted reamers. With holes cast in this manner the gear teeth run truer, and with less eccentricity than we have obtained by chucking and boring them, and the steel cores are more easily used than are sand cores.

As everything depends upon the setting of the core, we do not depend upon the fit of the flask pins, but put our core print all on one side of the pattern. Its straight part within the gear pattern is of less diameter than the core, affording a shoulder which holds the position of the core print proper. We make the core itself 1-16 inch longer in its straight part than the print is and the same length of taper, so that when the mold is closed the core is imbedded in the sand of the cope to a depth sufficient to leave the casting cut off clean. By making a free sliding fit between the pattern and core print the latter may be left in the sand while the pattern is drawn, it thus acting as a steady pin and being drawn separately afterward.

"Chills" swell through frequent use, while steel cores do not, and we find that machinery steel makes a far more satisfactory core than cold rolled. We are casting tap size holes in work to be tapped and experience no difficulty in securing good work. The core coating we use is the Star Steel Core Coating, handled by the S. Obermayer Company.

Of course in large work, or work of greater length, other allowance for shrinkage would be necessary, but for the purpose it is adapted to I believe this method unexcelled and less widely known than it should be. I have in mind a large agricultural implement factory where square shafts are used for half their work. They sand core as closely as possible and finish out the holes with files. To such a concern the saving in labor would be great.

LUCIEN I. YEOMANS.

Antrim, N. H.

A Maple Lap.

Editor American Machinist:

A. H. shows at page 476 a lap made of tubing. This lap may work all right, but it is not always at hand. I use a piece of maple and split it in the middle, leaving the ends solid, and expand with wooden wedges. This makes a good lap for drill bushings.

APPLEBY.

Color in Tempering.

Editor American Machinist:

The articles by your valued contributor, E. R. Markham, on hardening and tempering, have been among the most valuable and interesting matter in your pages, and I am glad to make use of this opportunity to express my appreciation and to thank Mr. Markham for a lot of useful information.

I have been waiting from week to week for him to reply to a query made some time ago by one of your other correspondents in regard to the color to draw work to. The difficulty which the inquirer had met was that a piece of polished steel took different colors in the spots that had become greasy from handling from the color on the part not handled. As the question has not been answered, I will endeavor to remedy the neglect by suggesting that the easiest way to get a uniform color is to grease the whole thing, and thereby avoid the ungreased spots.

Lard oil or vaseline may be used. There is a difference in the color produced by the two, and the user will have to do a little experimenting to learn just what shade is best for his work, bearing in mind also that the different steels do not have exactly the same properties at the same color. Our method is to brush the article with vaseline, then heat until nearly the desired color is obtained, then wipe the object with a rag or waste previously greased with vaseline. Strange to say, this wiping lowers the color considerably. Then we reheat and wipe again, with a less marked loss of color. Usually we get the desired color after the third wiping. This method enables us to produce a very rich and uniform color which makes quite an ornamental finish. Work colored with vaseline is darker than that colored with oil, and the latter is darker than the bare steel, other conditions remaining equal.

Detroit, Mich. L. O. DANSE.

Making a Pattern—Stopping Off.

Editor American Machinist:

Fig. 1 shows a drawing of a pipe for which a pattern had to be made. It will be seen that to have done it in the ordinary way—that is, to carve it all out of the solid timber—would have involved a lot of labor, and so it was decided to make it by a quicker and more efficient method. The timber was first built up in segments in the usual manner, only to form a complete circle instead of a half circle. It was then fastened to a lathe face-plate and turned to a semi-circular section; this ring was cut in two and the halves were placed together, back to back, thus giving a round pipe and a half bend, the flanges and branches *A A* being made separate and then fitted to it. The halves were simply doweled together and not securely fixed, because in most work of circular section similar to this the molding is facilitated if the pattern is made in halves, the molder being able to "sweep" the point or "parting" of his mold off the flat side of the pattern, thus insuring that the joint is exactly at the center of the pipe. The joint of the two halves of the pattern is represented by the line *B* and the lower part of the drawing (below *A B*) shows the method of sweeping the parting of the mold. The core box was made in exactly the same manner—that is, a complete ring was turned, cut in two, and then jointed by dowel pins. This finished, as far as we are concerned in this description, what was a very neat job, and one that took only about a quarter of the time it would have taken to carve it all out by hand. It may be as well to mention that it was a draftsman who suggested this method, and though I know it is often used on comparatively small work I have never heard of a job so large as this (6 feet diameter) being done by it.

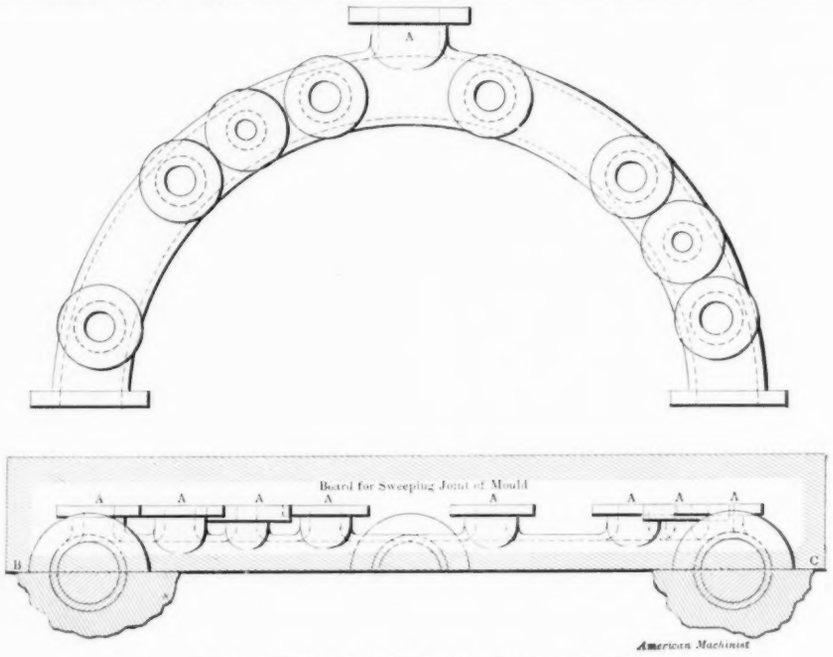


FIG. 1. HOW A PATTERN WAS MADE AND USED.

. . . . . .

Mr. J. M. Richardson, at page 613 of the present volume, gives a few interesting examples of stopping-off patterns, but unfortunately he leaves out what is in my opinion one of the most useful applications.

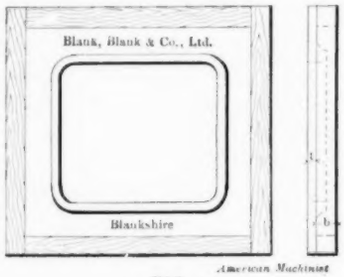


FIG. 3

Fig. 2 is the pattern for a radial drill base-plate, and it was required to cast one off it a bit shorter than the original. A rib *B* was fastened inside to serve as the end of the new length of bed; two core-prints were then screwed on, one on each side, with their edges in a line with the rib *B*, as shown by the dotted line. A core box, Fig. 3, was then made having the depth *b* equal to the depth *b* of the core print *A*, the length and breadth being such as fill the space in the mold left by the prints *A A*, thus stopping the molten metal from flowing past the new end of the bed. A beading similar to *C C* was put into this core box, on the bottom or back *t*, which is, it should be noted, the same thickness as the end of the bed *B*. The maker's name also was put in, as shown in the sketch. The T-groove core prints were not touched at all, the molder simply cutting off his cores to such a length as would come up against the stopping-off core. It will be seen that by this method 6 feet may be stopped off just as easily as 6 inches, and it may be used on lathe, planer or any other beds where it is required to cast different lengths off one pattern.

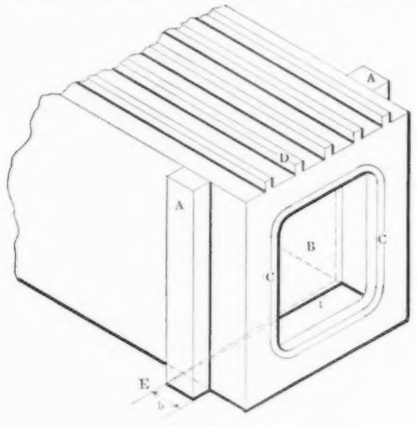


FIG. 2

STOPPING OFF A MOLD.

ALBERT CLEGG.

Keighley, England.

Lumber and Scrap Racks for the Pattern Shop.

Editor American Machinist:

At page 808 Mr. J. L. Gard, under the head of "Some Pattern Shop Economies," has something to say about the scrap pile. The prodigal waste of lumber generally was something that surprised me when I came to this country, over twenty years ago. When a youth I worked for a man who used considerable ash in his business as an agricultural implement maker. He generally bought the trees standing, so of course the branches were his also. Those branches were cut up and turned into file handles or handles to go on the cranks of some hand machines. One of his men needed a small piece of this ash to make a carpenter's mallet to work with. He got it by asking for it, but he had to pay threepence for it.

Fig. 1 shows a "scrap rack" which I find very convenient. The sizes are as shown. The top shelf or line of strips is about as high as most men can look over, and the bottom rails, 12 inches high, are so that the broom can go under easily. There are really four shelves or decks, al-

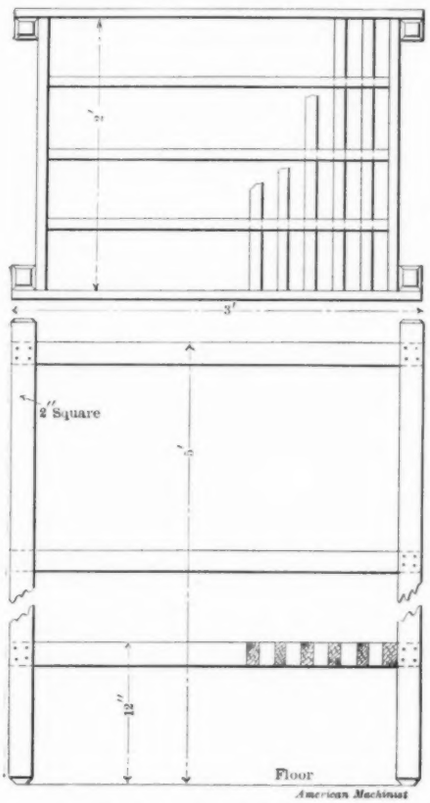


FIG. 1. RACK FOR SCRAP PATTERN LUMBER.

though I have shown only three. The bottom rack has sides 3 inches high all around, and the others except the top have end pieces the same, not shown. The three upper shelves had three strips only, running lengthwise, while the bottom had several running across similar to those shown. The bottom ends of posts had liberal chamfers, so that we could move the rack easily by sliding it on the floor if needed. An arrangement of this sort enables one to see at a glance what there is on either shelf and everything is off the floor.

Fig. 2 shows a rack for standing lumber, lack of room compelling me to adopt this plan of keeping it, but as it fills the bill admirably I am glad to have it. There is a slanting rail with holes for ⅝-inch rods bored at a distance to allow 3-inch material to drop easily between, which is the thickest that I stand on end. Of course these spaces are used for all thick-

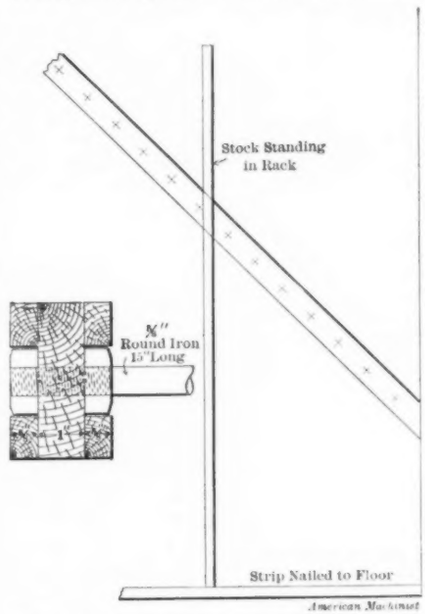


FIG. 2. RACK FOR STANDING PATTERN LUMBER.

nesses carried, several thin boards being placed in one space. The detail in cross-section explains itself. The rods, projecting 15 inches, are threaded on one end long enough to receive two nuts, one on each side of the rail which is 1x3½ inches. Strips are nailed back and front of the same, coming flush with the faces of the nuts. The sketch shows the rail fastened to the end of the building, one end starting from the side, about 2 feet from the floor. A strip is nailed down on the floor 12 inches out from the end, plus the thickness of the rail. The stock standing on end resting on this strip throws the weight of each board or plank in against the rail.

WM. NEWTON.

Milling Cutter Arbor Drives.

Editor American Machinist:

Regarding Mr. Ridderhof's opinion that his method of driving milling cutter arbors (page 1120) is superior to mine, I admit that such is the case where a person has trouble in keeping the arbor from coming out, but in our particular case we were simply cutting gear teeth and there was no tendency to work out. Furthermore, I always slip a leather washer over the end bearing, then butt the overhanging arm against the arbor "good and proper" and tighten the same. Using this method and tapping the arbor into the spindle with a babbitt hammer, using good solid blows, we have never had any trouble with the arbor coming loose. Then, again, according to Mr. Ridderhof's method, it is necessary to make new arbors, with the lugs solid on the heavy part, which makes the operation quite expensive, whereas by my method the arbors which generally come with the machine can be utilized, driving them by the tang only when used on light work. In regard to using a rod tapped into the end of the arbor, as mentioned by both Mr. Ridderhof and Mr. Newton (page 1123), the idea is O. K., providing it is needed; but I believe if the gentlemen will insert their arbors in the manner I have described they will not need to go into the expense of drilling and tapping the ends of the arbors and using long cumbersome rods.

I think Mr. Ridderhof's method of removing the arbors is O. K. Mr. R. says in his article that there are but two pieces, the collar and the arbor, no screws or other additional parts. I can see no objection to using screws in the manner I did to hold the tool-steel keys. This driver gives excellent satisfaction and is, I believe, cheaper to make than Mr. R.'s, taking into consideration all the stock that must be cut away.

Mr. R.'s comment upon the unnecessary feature of my figuring on the tang driving is a point well taken, owing to the fact, as he stated, that the new style of driving takes the entire job off the tang.

I thank Messrs. Ridderhof and Newton for their part in the program.

ROBT. A. LACHMANN.

A Taper Gage in a Jobbing Shop.

The following letter we attempted to print in our issue of August 7, but in the make-up some lines of linotype dropped out, leaving the rest unintelligible, so it is best and only justice to the writer to reprint the entire letter:

Editor American Machinist:

I have read with interest the descriptions of the different devices for calipering tapers recently shown in your columns, and no doubt some of them are valuable. I would like to describe a simple and cheap method that I am using. Several years ago while I was employed in a jobbing shop in the oil country (one of Mr. Osborne's kind) a man came in with a cross-head pin and box and wanted a new pin made, but he did not bring the cross-head, for they were unable to get the key out and get it off the piston rod. Both ends of the pin were taper and the centers in them were battered so that it was impossible to set the taper attachment to it. I suggested to the foreman a cheap gage that would only take an hour to make and was told to go ahead. I took a bushing somewhat longer than the pin, stood the pin upright in it, filled the wrist part of the pin with clay and on top of the clay I put pasteboard washers. Previously I had drilled some holes in the bushing for the

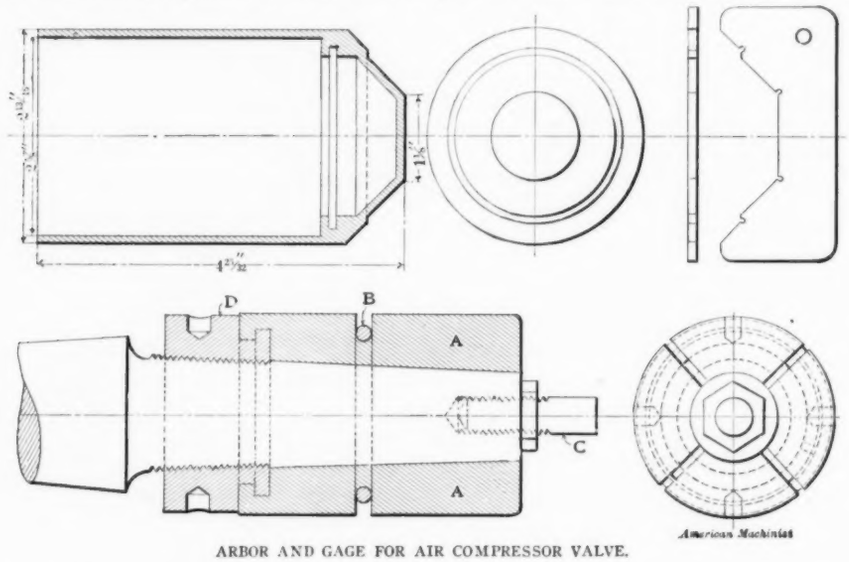
babbitt to hold to; then I poured babbitt metal into both taper ends. After the metal had set, I took the job to an old screw press and pressed it tight, then after removing the pin I had a gage.

A few weeks ago I had to make some taper reamers for pins; I had the pins but no gage, so I made a gage after the above method. After I had one reamer ground I made a more substantial gage; it is faster than bothering with a micrometer or guessing. Maybe this is old, but I never saw it practiced, so I will hope it may help someone. CHAS. HEENA.

Machining an Air Compressor Valve.

Editor American Machinist:

I enclose sketches of an outlet valve, an expanding arbor for machining the same, and a gage to which the end is turned. Fig. 1 shows the valve and the gage. The valve, which is used on several styles of air compressors, is a steel casting and is first chucked in the usual way, the seat end of the valve coming up against a stop in the rear of a four-jawed chuck. The end is faced off and the valve is bored out by a series of fixed cutters set in boring bars. It is then ready for the outside turning. Fig. 2 shows an expanding arbor that is fitted to a lathe spindle; the four jaws *A* are kept in place by the spring *B*. The valve, finished inside, is slipped over the arbor and held up against stop *C*. The nut *D*, which is drilled out for an ordinary spanner wrench, is then



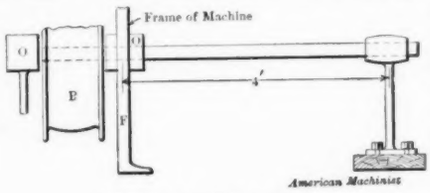
ARBOR AND GAGE FOR AIR COMPRESSOR VALVE.

tightened, the outside of the valve is turned to a ring gage, and the end of the valve is turned to the gage shown in Fig. 1. C. O. D.

Fixing a Loose Pulley.

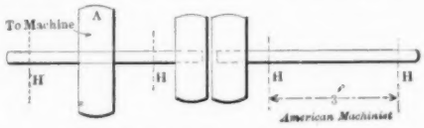
Editor American Machinist:

In a wood-working shop in which I was employed there was a machine which gave a great amount of trouble and more than once caused a delay of three to six hours, owing to the heating and sticking of a loose pulley. The pulley ran on the shaft, with a short bearing on each side of the pulley. This pulley was a sticker, and it always got in its work when the superintendent was near at hand and always ready to make a great kick but never a suggestion to help out of the difficulty.



FIXING A LOOSE PULLEY.

Red tape in a shop is all right; but they worked it for further orders in this shop. One day, after being disgusted with the machine and the red-tape business, I took hold and changed the arrangement, as shown in the sketch. The change de-



A RECONSTRUCTED COUNTERSHAFT.

manded a little more floor space, but now they can run the machine all day without the heating or sticking of the pulley.

Referring to the sketch, *o o* are the old bearings. I took an old hanger and placed it about four feet from the machine and put in a shaft with length enough protruding inside the machine to key the pulley on. It looked bad, but it did the work. The machine pulley change worked so well that I thought I would try it on a countershaft. This countershaft ran a re-saw which was being worked to its full capacity, and for this reason a tight belt was necessary, with the hot pulley as a result. The counter had three hangers, so I just made it four and cut the shaft in two, with a tight pulley on each piece. I never saw anything answer the purpose as this does. WOODWORKER.

Marking Details to Fit—Long Bolts Elastic—Fine Thread for Large Bolts.

The practice of marking upon a drawing that one detail must be made to fit another has its limits, especially in a class of work likely to bring many orders for spares. I remember a case in which the draftsman noted upon the detail for a large nut that it should be chased to fit a certain rod shown upon another sheet. The nut was not an ordinary one, but was a somewhat elaborate affair, part of a system of heavy machinery, and when the lathe hand was ready to chase the thread it was found that the rod had already been shipped, and the man who had finished it had gone to another town to work. The threads were shown on the rod detail in the conventional manner, and the presumption was that it had been chased for a standard bolt thread. This proved to be the case all right, but the matter caused considerable discussion. The lathe hand had asked to be definitely instructed to chase a standard thread in the nut, the shop foreman, in some little doubt himself, referred the matter to the superintendent, and the latter mentioned the case to the engineer, who at once reprimanded his draftsman for marking the drawing in this way. The rule was then formulated for that drawing room that pieces of standard dimensions, or of other dimensions which could fairly be given in figures, were not to be marked fit one to the other, but, so far at least as the draftsman was concerned, the presumption must be made that each machinist would work accurately to figures; and that if for any cause this was not done in a given case, the matter would be reported to the drawing room to be noted upon the drawings. This was in a class of work for which ordinary machine shop methods were sufficiently accurate, and would produce parts that were practically interchangeable.

. . . . . .

In the case of very large bolts and nuts, such as tension bolts for shears, presses, etc., the use of a thread finer than that corresponding to the given diameter is so commonly resorted to, in order to preserve the strength of the bolt, that it is well in all cases to mark the number of threads per inch, and if this is not done a careful man will assure himself of the requirements in the case before boring out the nut or chasing the thread upon the bolt.

. . . . . .

Many mechanics have wondered why it was they were given the job of turning stock for almost the entire length of a large bolt in order to reduce the body to the same diameter as the root of the thread, or even slightly below it, and then, in some cases, providing split bushings to fill the space between the body of the bolt and the holes through which it was passed, thus supplying the place of the metal they had been at some pains to remove. Those of an inquiring turn of mind readily learned that to thus reduce the diameter of

the bolt increased its strength by rendering it more elastic, allowing it to stretch somewhat in place of breaking. In the case of a full-bodied bolt the section which offers the least resistance to tension is that at the root of the thread; it will stretch proportionally more at this section, and it is here it will break, and it will do this under a smaller load than if the elongation had been distributed over its entire length. In bridge and building construction, the tension rods and sway rods that have threaded connections are made with upset ends; that is, the ends are stoved up to suit a nut a size larger than the body of the rod, which is then smaller in diameter than the root of the threads, and the rod will always fail at some portion of its length other than the ends. Bolts which are subject to repeated shocks or vibrations are sometimes provided with rubber cushions between large washers under the nuts; this is said to lessen the tendency to crystallization of the metal and increase the life of the bolt.

Machinists, especially fitters, have noticed that the man with the monkey-wrench will oftener break short bolts, such as those used for cylinder heads, than he will those of the same diameter but which happen to be 2 or 3 feet long. Men in the shop who have used a 1-inch bolt with a long wrench to pull bronze bushings into place have frequently remarked that the long bolts never seemed to break, while with a smaller wrench they could break a short bolt drawn up on to solid metal. In such a case as this there would rarely be sufficient resistance to break the bolt. Although the men felt that they were pulling with as much force as served to break the shorter bolt, the yielding of the bushing, added to the elasticity of the bolt, would prevent the force coming as a suddenly applied load, or in the nature of a shock, which is a most common cause of failure in all kinds of construction. The principle that a suddenly applied load produces double the stress that is caused by the same weight added in small increments governs the case of the bolt, no less than that of a railroad train rolling suddenly out upon a bridge.

GERALD E. FLANAGAN.

Arrangement for Boring Crank Disks.

Editor American Machinist:

The readers of the AMERICAN MACHINIST have of course profited by the well-sustained succession of articles on tool-room work, dies and press work, etc. However, there are others more directly interested in the common, everyday jobs of the machine shop, and hoping to bring out other ideas in kindred work, I offer a sketch, Fig. 1, and description of a method I designed and used in the shops of Clark Bros., Belmont, N. Y., for boring the crank pin holes in the disks of their engines.

The shafts are not of one size through the entire length of the disk hubs, but are stepped down 1-16 inch in diameter at half the length in the hub, thus obtaining a better and quicker job when pressing the shaft in place, for a quick, certain alinement is secured at the very beginning of the pressing operation, and also the time required for forcing the shaft through the disk is cut in half. For short stroke, large cylinder engines having large shafts and pins this step is increased (see Fig. 2), and the crank pin also is made with a step, thus giving additional metal between shaft and crank pin holes.

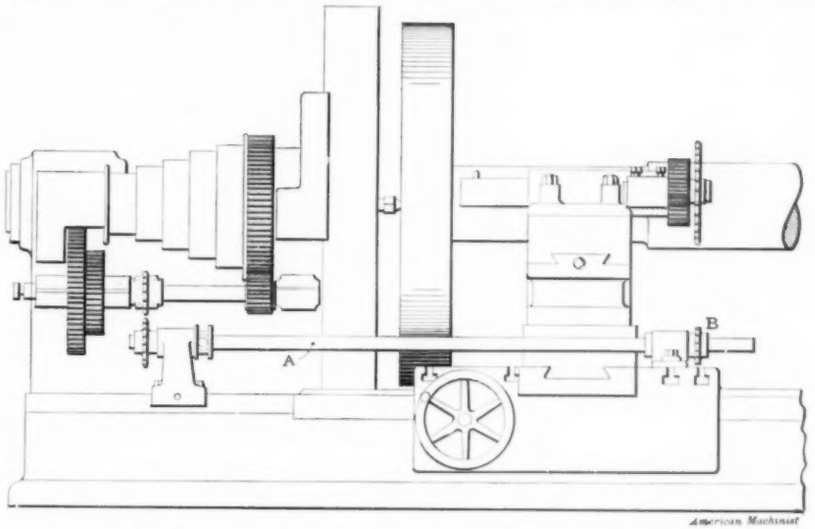


FIG. 1. LATHE ARRANGEMENT FOR BORING CRANK DISKS.

The shaft with the fitted disk is placed on the centers of the lathe, which has been arranged for this operation, and the accompanying drawing shows the simple, cheap and effective device in use. The shaft *A* is driven by the split clamp sprocket wheel on the gear shaft of the lathe head. The other end of this shaft, having a long spline, is carried in the solid box on the lathe carriage by the sleeve of the sprocket wheel *B*. The stiff cast iron box bolted on the top of the tool rest carries the cutter bar together with the driving sprocket wheel and the two gears, the gears being required to enable the sprocket wheel to clear the body of the crank shaft. The feed is the regular carriage feed, the carriage and cutter bar traveling together. The disk is of course fastened so that it cannot turn. There is no chucking nor uncertain squaring of the work; the error of the finished hole is no more than the error of the lathe, which, with a long shaft and for the comparatively short crank pin seat, is exceedingly small.

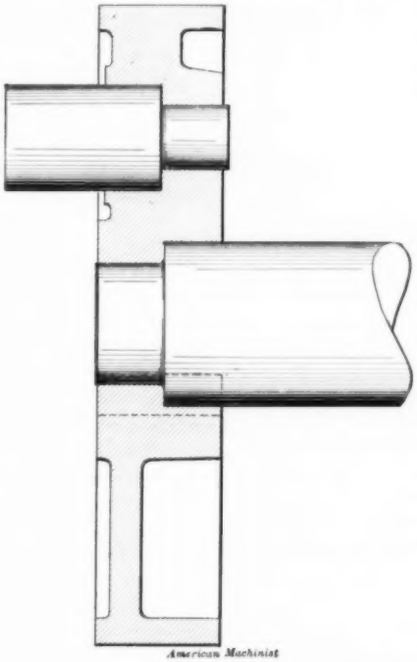


FIG. 2. STEPPED HOLES FOR SHAFT AND CRANK-PIN.

JOSEPH L. REID.

The Vise on the Patternmaker's Bench.

Editor American Machinist:

A workman in the shop with me called my attention to what he termed "a foolish thing to put in a paper," in the "Pattern Shop Suggestions" at page 807. The article shows a bench with a vise 6 inches from the end. Said he, "What's the difference where the vise is, 6 inches or 20 inches from the end?" Said I, "I have been a reader of this paper for eighteen years and I can learn something from each article published. The trouble with some readers is, they read the whole paper in five minutes and then start to kick.

"Now let us do a little experimenting. The vise on your bench is 21½ inches from the end. Now take your plane and use it in the regular position, with your right side to the bench; that's easy. Now leave the piece in the vise and turn around and plane the other way; that's not so easy. Just try that on my bench; the vise is 5 inches from the end." "Well, I guess the idea is all right." Life is short, so there is no use killing oneself trying to reach down to the center of the bench when dressing a piece of wood.

SUGGESTIONS.

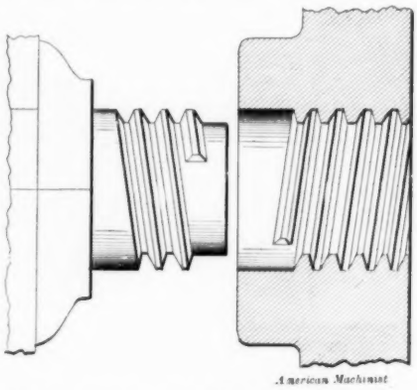
No Encouragement to Improve.

Editor American Machinist:

Your kindly and helpful suggestions as to some of the things to be kept in mind when writing for publication encourage me to write you. I'd like to tell you of a lathe that is one of the best in a department employing about fourteen men day turn and a lesser number nights. The machine I have in mind is an 18-inch swing of standard make, about 4 feet between centers, and has been in use about two years. There is nothing about it badly worn, and in most ways it shows evidence of light cuts and reasonable oiling. One of the first things to attract my attention was that the countershaft never stopped—except when the operator had the har'i-hood to ask the machine to take such a cut as an 8-inch swing lathe might reasonably be expected to handle, then it stopped. It was said by the foreman, and others who claimed to know, that the clutch was wrong, had always been wrong, and could not be made right. The belt from the line to the countershaft had a great tendency to run almost any other place than well on the pulleys, and the belt from the counter to the machine was seldom more than half its width on either pulley. The men who ran the lathe, probably because of thwarted attempts to have these things changed for the better, seemed to be fairly content to set cuts, speeds and feeds where such an arrangement, with rather loose belts, woul ' drive them, then fold their arms and let her nibble.

I'd like to send you a photograph of that lathe. I fancy it might be taken for a photograph of many another lathe in this land of ours. There was little about it that could be called startling. The machine was provided with a full equipment of large and small face-plate, four-jawed combination chuck, steady-rest, follow-rest and a small Beach drill chuck. All of these except the last named and the follow-rest were resting around the feet of the lathe, more or less encrusted with dirt. The threads in all pieces that screwed on to the spindle were filled with chips and dirt and left just as they were cut; that is, not one had ever been provided with a blunt termination (see sketch), but each tapered to nothing, thus insuring that vexatious "cross-thread" action so likely to occur when putting on face-plates, chucks, and such. The follow-rest was found far away from the machine. It was seldom or never used. The steady-rest was so encrusted with grease and dirt that in only a few places was the metal surface visible. The upper part was hinged and clamped to the lower in the usual way; the clamp had been broken and a new one made that was so long that the clamp screw would not touch bottom, and a piece must be inserted under the screw point to lengthen it. The Beach drill chuck had been made for straight shank drills, and used for taper shanks till the taper shell that is supposed to hold the jaws in correct position was strained, allowing the jaws to gape to the taper whenever any pressure was put on them. This chuck was provided with a shank that fitted head and tail spindles, except that it was so short that it could not be knocked out, and it had to be taken out with a wrench. It was not much used, but in its place was another Beach chuck in somewhat better condition, but with a shank that did *not* fit the lathe spindles, which was used to the detriment of the spindle holes and of the fit of the centers.

At the back of the lathe, in a rather difficult place, there had at one time been a board with pins scattered promiscuously over it, the intention being to keep the change gears thereon; but little effort was made by the workmen to do anything of the kind. Some entirely too slender and limber nails had been driven into a cupboard that stood near the head end of the lathe and some of the gears were there; some were on the floor, some on the first mentioned board and all more or less filled with dirt and chips. The keys that kept these gears from turning when in use were of the Woodruff type and of course were



END OF SPINDLE AND HOLE IN CHUCK WITH SQUARE-ENDED THREADS.

loose. The knurled nut that at one time retained the gear on the end of the spindle had been lost and nothing substituted. The operator was supposed to give it and the feed cone some attention and shove them on when they worked too far off. The back gears and mating gears on the cone were as full of dirt and chips as they could be and run; the pinion at the small end of the cone had met with an accident and had been repaired by making some pin teeth that furnished an indicator for the cone speed—when back gears were in action—which could be read all over the department. This lathe was provided with an arrangement of gears whereby the carriage feed could easily be shifted from belt drive to gear drive, by turning a knurled knob a few turns, thereby shifting the position of a swinging bracket situated at the left-hand end of the lead screw and feed rod, in such a way as to slack the feed belt and bring into action gears connecting the lead screw and feed rod. This swinging bracket was somewhat cup shaped and so full of chips and dirt as to prevent its normal action and wholly hide some oil holes. The tailstock seemed to have been provided with a clamp of usual one-bolt design, but some thoughtful man had cut away the part that fits between the lathe shears till the clamp refused to stand still while the nut was being tightened, requiring a hand to be placed on it each time it was tightened.

And so I might go on mentioning each part of the lathe. There was nothing really alarming or wonderful about the machine, but if there was much that was very near to what it should be, it failed to come to my notice.

During the few weeks that I was in sight of this lathe there went to work on it a man who tried to bring it up to its full producing capacity and was encouraged by many promises and a change of foremen to believe it could and would be done. I'd like to tell you that the man changed things for the better, but that would not be strictly true. There was no evidence of any determination on the part of those in authority to actually prevent him from improving matters, but there was very little done to help him. Many of the faults were easily corrected, but others required the co-operation of the foreman. The chances are that with enough time and with never-relaxing effort there would have been a cure of all. As it was, on leaving the machine after about three months' work, he could say that it could easily be run to double the capacity that was possible when he took it, but that was still far short of what it should have been.

In too many shops this pen picture of the lathe will be recognized as showing what they consider the normal condition of a lathe, but how far it is from the condition in which a lathe should be maintained will be apparent to those who are fortunate enough to work where they do better.

H. O. Bow.

Work Benches Without Shelves.

Editor American Machinist:

A visit to almost any modern machine works is always instructive. While the machine equipment may leave but little to be desired, it is almost invariably apparent that no attention has been paid to the type of work bench best suited to prevent the same from becoming repositories for a generous portion of the shop refuse, which, by a very gentle stretch of the imagination, might be made to include the spoiled work, hidden and "government" jobs under way stowed in the various nooks and corners formed by shelves under benches, so kindly provided for this particular purpose.

In a manufacturing machine works which I have in mind, they have all their benches, including those of the pattern shop, boxed up from the floor right up to the under side of the bench and a foot or so back from the front, which allows ample space for fastening vises and clamp-

ing work, as well as for the numerous other operations that make benches necessary, with the result that when the grand semi-occasional cleaning up does take place, there are *not* found, reposing restfully on the hereinbefore mentioned shelves, partly used bales of "hay" tobacco, several well-seasoned "sojers" of the same material, cigarette stumps galore, with a helper's half-filled, well-colored, odorous T. D. clay pipe here and there to lend proper dignity to the collection. Added to this list will be the usual scrap metal that will accumulate in all machine shops, regardless of the imposing and ever-present scrap pile which would at least be in evidence when wanted if all benches were shorn of shelves and boxed. OLD BOB.

Narrowmindedness in the Shop.

Editor American Machinist

We see a lot just now in the technical papers, especially the AMERICAN MACHINIST, about up-to-date shops, liberal mindedness, works management, etc., features which can be found on this side of the Atlantic as well as over there; but it isn't very often we hear about the other side of the question, and I should just like to present a case to show how British workmen are sometimes encouraged. A year or two ago a prominent firm of textile machine makers installed in their works an automatic screw machine. This was at the time a novelty in the district, and a young engineer who had mastered all the principles of these machines, but had never had the opportunity of seeing one in operation, wrote to the said firm telling them that he understood all the mechanism of their machine, but, having never seen one working, he would esteem it a great favor if they would allow him to inspect it. He waited with more or less patience and at last received a reply to the effect that he must have made some mistake, as no one in the district understood anything about the machine he referred to, and therefore they could not see their way to grant his request. I don't know whether such people do tricks like this to keep those who may be future competitors from the field or whether it is from pure "cussedness," but, whatever it is for, it only serves to spur on the ambitious young man. At the same time it is self-evident that when such practices as these are indulged in the road to success is of necessity much longer.

Another incident which came under my notice, worse than the above but of a different character, was enacted about a couple of years ago, the principal actor being the manager of a machine tool works employing about 300 hands. This man was one of the most vulgar and profane creatures that I have ever met (and I have come across a few "stars" in this line). This may be judged from the fact that he has cursed his own father (who is a senior partner) more than once, and that, too, in the presence of the workmen. The works had increased and multiplied till the engine had got unable to cope with the load put on to it, and the heads of the firm (among whom was the above thick head) had decided to install a new engine of greater power. One day, when all were quietly pencil-pushing, this genius came rushing up into the drafting room with an unusual amount of bluster (a characteristic for which he was famous) and told the chief draftsman that he had solved the difficulty about the engine. The C. D., not understanding what he meant, asked for a fuller explanation, and he then said that he was going to put a two-to-one purchase of gearing from the engine crankshaft to an auxiliary shaft from which he would drive the shop, concluding with the words, "I shall then have exactly double the horsepower from the engine, don't you see?" When our boss recovered he tried to explain the meaning of the word horsepower, and it is unnecessary to add that a new engine is now driving the works.

Another rather amusing incident which occurred at the same shop goes to show that the above manager was a regular "chip of the old block." A large packing case was being sent away, and the Old Man (our hero's father, who was always very much in evidence when anything was being sent out) was standing on the dray after having steadied the case down from the crane. The horse, owing to some inequalities in the shop floor, could not start the load. After a lot of shouting about a dozen men were ranged at the back of the wagon, and at a signal from the Old Man a mighty shove was given, the Old Man in the meantime heaving for all he was worth at the packing case *while he was still on the* wagon. The result was the most ludicrous that could be imagined, the Old Man pushing and the men trying to suppress their mirth, at the same time pushing with all their might. Y. Z.

Yorkshire, England.

Grinding Out Dies.

Editor American Machinist:

We had at one time a set of three blanking dies that "went in" in the hardening, so we ground them out as per Figs. 1 and 2. From 1-32 to 1-16 inch had to come out. Emery wheel *A*, which is 6 inches in diameter (and a hard rubber wheel it ought to be) is belted up to run 2,800 revolutions. I had three soft wheels at first, but they all flew off at a tangent and nearly scared the "bats out of the belfry." The frame that holds the grinder

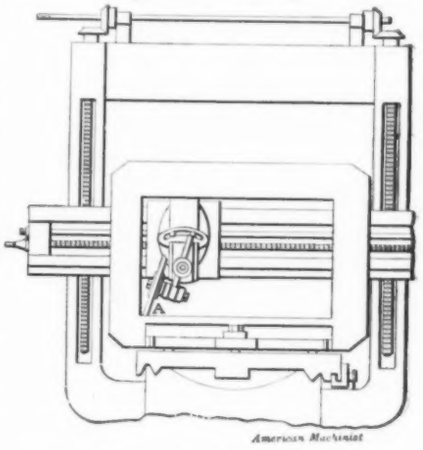


FIG. 1. GRINDING A DIE.

shaft is reversible at *B*, and the emery wheel can be turned around without unlacing the belt. CARROLL ASHLEY.

Holding Back a Twist Drill in Ratcheting.

Editor American Machinist:

I have had all kinds of trouble from twist drills catching in going through a hole, especially when using a ratchet, and I devised a scheme to prevent this, which proved effective and a time-saver for me.

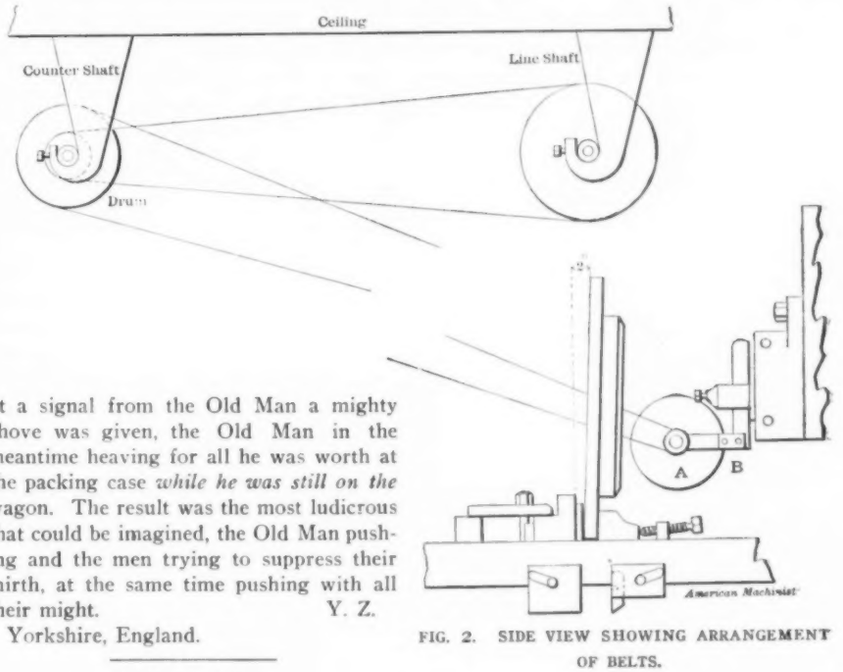


FIG. 2. SIDE VIEW SHOWING ARRANGEMENT OF BELTS.

Just take a block of lead or babbitt and clamp it on where the drill is to break through. Where it is difficult to clamp the soft metal it may be held by bracing. At any rate it is a comparatively simple matter to hold the block in some way, and as the drill has the block to enter it will not have the chance to catch and screw itself

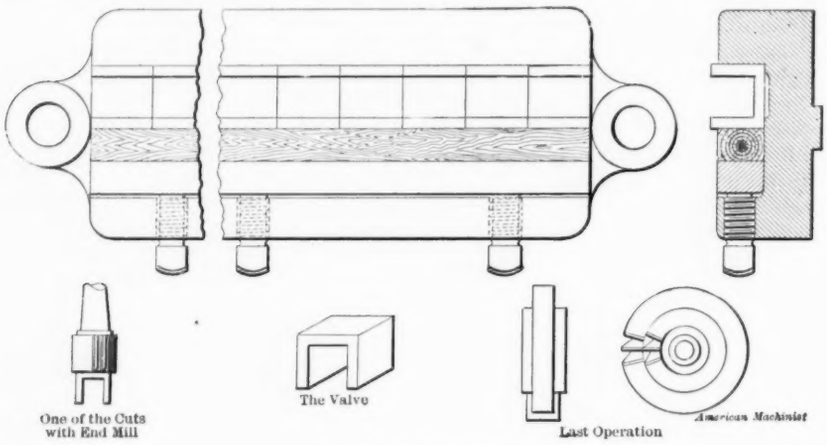
forward. After once using this a mechanic would not try to ratchet with twist drills, say ¾ to 1½ inch, without it.

ROB'T A. LACHMANN.

A Long Milling Jig.

Editor American Machinist:

A small U-shaped slide valve, about ¾ inch square, has to be finished all over. The work is done on a milling machine with end mills and gang cutters, and the device for holding the castings is the subject of this sketch.



A LONG MILLING JIG.

The jig used is made up of a casting nearly as long as the travel of the table of the machine, milled out as shown in the section; a piece of hard wood as long as the jig and about ¼x¾ inch; a piece of machine steel the same size as the piece of wood, and six set-screws tapped through the casting.

About thirty of the little castings in the rough are laid in a row in the jig, all the same side up. A cut is then taken the whole length with an end mill and then the castings are turned over. This is repeated until all the outside faces have been finished, when a gang of three mills is put on and the last cut is taken, as shown in the engraving. The same jig holds the castings during all six operations, and as thirty can be done at a time it saves quite a percentage of the former cost. The hardwood strip is elastic enough to take up the inequalities of the castings, so that the extra wide ones do not get all the pinch and leave the narrow ones loose. We are going to apply this principle to a lot of our small milling jobs.

ROGER HAINES.

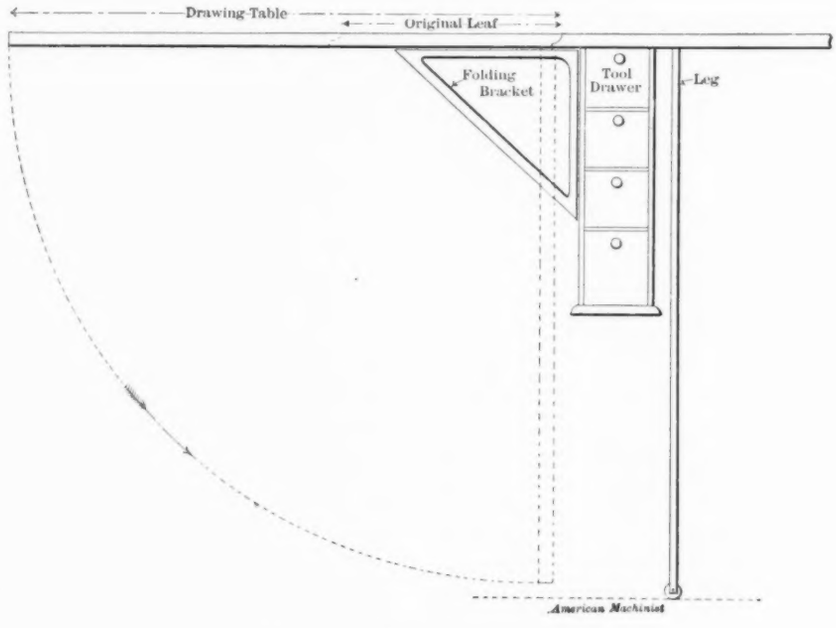
A Sewing Machine Drawing Table.

Editor American Machinist:

I send a sketch of a drawing table which I made and which is as convenient as any I ever saw. Most mechanics, draftsmen, contractors, etc., have a drawing board *at home*, and find it hard to get along without one of some kind. It is not very convenient or pleasing to the eye of a housewife to see a drawing board set up all day in the parlor, dining room or kitchen, and it is anything but convenient for a man to be obliged to get out a drawing board after supper and find all the tables occupied and no place to lay the board.

At home we have a sewing machine which had a drop leaf at the side. I removed the drop leaf and in its place put a soft pine board 2 inches wider than the length of the one taken off and long enough to reach the floor when dropped down, making the board 30x20 inches. The top drawer in sewing machine—which is fitted with lock and key—I kept drawing tools, etc., in, which is a good feature, as the tools are safe away from little children and you are sure to find tools, pencils, etc., the next time you want them and when drawing the tools are at your right hand. Aside from the handy drawing board feature, my wife says she would not have the board removed if I never used it for drawing, as it is far more convenient than the original table for sewing purposes.

D. E. M.

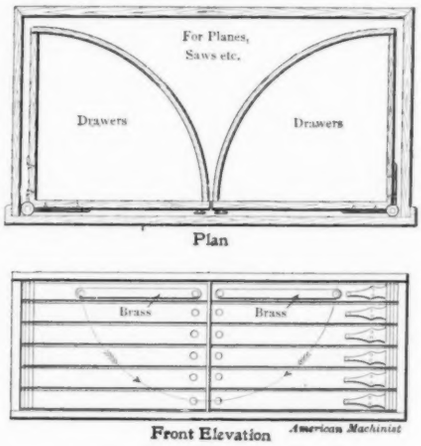


A SEWING MACHINE DRAWING TABLE.

A Handy Tool Chest.

Editor American Machinist:

I send herewith a sketch of a tool-chest made by myself and a friend. It is very practical and convenient. The sketch shows how the drawers are shaped, made in quarter segment and just deep enough to hold the tools without putting one on top of the other. Each drawer has an ornamental brass hinge which also serves the purpose of a corner bracket. The hinges swing on a ½-inch rod, which extends from top to bottom of box.



A PATTERNMAKER'S TOOL CHEST.

The drawer pulls, as shown, serve two purposes: to open one drawer at a time, or all at once. This latter is accomplished by a brass plate, as shown, which has a hole drilled near one end through which the pull in the upper drawer passes. The plate is made long enough to extend down to pull on the lower drawers. When in a vertical position the plate is under all the drawer pulls, which thus provides a means of opening all the drawers at once.

Before making my chest I first made a full size sketch of the drawers, which gave me a start on the size of box or body, which can be put together according to the ideas of the maker. The chest opens at the front and is intended to be placed under or on top of the work bench, the latter preferred. My aim is to make a chest which will hold all the belongings of a mechanic—not any larger than necessary—and convenient and handy.

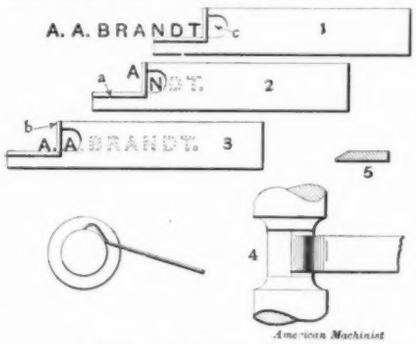
As shown in the sketch, all the planes, saws, etc., are put in the back of the chest and can be reached at once. The "dress-suit-case-tool-chest" is very good, but I prefer a chest that is large enough to contain my tools. Not long ago a friend bought an augur bit brace. He had a "dress-suit-case," but the augur bit brace would not fit in it, so there you are.

TOOL CHEST.

Letter-Stamping on Steel.

Editor American Machinist:

To make letter stamping on metal in straight lines an easy job, I advise readers of the AMERICAN MACHINIST to make use of the little templet or templets shown in the sketch. The templet is made of 1-32 inch sheet steel. The edges *a* and *b*, by



A GUIDE FOR LETTER STAMPS.

which the letter stamps are located, are beveled as shown on an enlarged scale at 5. The D-shaped hole *c* helps to keep equal distance between the letters (see 2 and 3). In using the templet the beveled edge *a* is placed to coincide with the line on which the letters are to be stamped. It is kept in this position by the right hand, while the left takes hold of the letter stamp and puts it gently against the edge *b*, and slips it with a very light pressure on the latter towards the edge *a* till this brings it to a stop. The letter stamp is then held in this position while the templet is slightly withdrawn and the stamp is struck with the hammer.

In using this templet the operator begins with the last letter of a line—for instance, *T* in the name of A. A. Brandt; then *D*, *N*, and so on.

4 shows how a bent templet can be used in stamping on a round job. Letter stamps are held best by the upper end with a very light pressure on the surface to be stamped—not with cramped fingers, which makes steady holding difficult. A. A. BRANDT.

Birmingham, England.

Unjustifiable Fault Finding.

Editor American Machinist:

I always contend that there is no rule for a patternmaker to be governed by in the construction of a pattern. A foreman has his idea of how a job should be done, and, after studying a drawing so that he understands it, he hands it to the patternmaker to make the pattern called for. Now if, after going over the drawing, the foreman knows how he wants the pattern made, but does not instruct the patternmaker to that effect, if the patternmaker makes the pattern to the best of his ability and the pattern answers the purpose for which it is intended and is easy to mold and gives a correct casting, the foreman has no right whatever to "jump on a man" and "call him down." If there is only one casting wanted and you can get it from the pattern as made, what's the use of kicking? If you want the pattern made after your ideas, then tell the patternmaker how you want it made. He is not supposed to read your mind, and, in fact, he is often kept busy enough in reading the drawings made by some of the "made while you wait" draftsmen that he bumps up against nowadays.

Here is an example of a kicking foreman who did not know what he was kicking for. In a shop where I was employed there was a large pattern to be made, on which was a foot-plate, 12x26⅛ inches, and on the foot were fitting strips, ¼x1x12 inches. In making the foot-plate I allowed 1-16 inch draft in 12 inches, or the width of plate; I also allowed that amount or a little more on the strips. The foreman came to me with a look of disgust and started in at once to do the "jump act," saying, in part, "If you knew your business you would make the strips ¼ inch wider on the cope than on the bottom end." I explained that I made the fitting strips with the same taper as the ends of the plate, and I could not see where any more taper would be of any benefit to the molder. The molder's opinion was asked, and he said that it made no difference to him if the pattern was twice 12 inches wide and if the strips were straight and not undercut. This tended to show that I knew my business better than the foreman did, and he took advantage of every opportunity after that to make things unpleasant for me until I quit the shop. Does that kind of a foreman pay? I think not.

PATTERNMAKER.

Tallow for Cutting Tools.

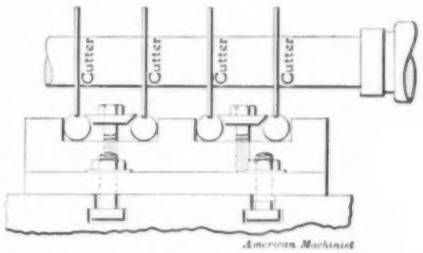
Editor American Machinist:

Among the many valuable hints and kinks that I have found in the AMERICAN MACHINIST in my fifteen years' reading of it, I found some time ago one about the use of bees-wax for cutting threads on copper. It reminds me of a trick I stumbled against some time ago. At the time I was working in a jobbing shop in Chicago, and I had a special 1-inch tap to make and found it impossible to cut a smooth thread with the kind of oil they had in the shop, some cheap brand of machine oil; and as the boss didn't like to buy lard oil, I happened to see an old piece of candle lying back of the lathe and it struck me all at once to try it on the tap, and I found it to be just the thing. I have since come to prefer a candle for cutting threads, as it is much more convenient and also cleaner to use than oil. It doesn't run all over the lathe, there is less waste, and you don't have to have a special oil can for lard oil. On small work the heat from the friction of the cutting tool and the center is sufficient to melt the candle, and on larger work the heat in the chip will melt it as the tool goes along. In cutting inside threads it is equally handy and clean, as it stays right with the work. I also use it on my centers to keep them from squealing; it beats white lead, etc. Many of the boys will find this handy when working in the backwood shops. GEORGE NELSON.

Chuck for Holding Shafts for Milling.

Editor American Machinist:

Recently I had a quantity of light shafts 9-16 inch diameter to groove the entire length, about 3 feet, with ⅛-inch keyways. To have grooved these singly would have



CHUCK FOR HOLDING SHAFTS FOR MILLING.

taken considerable time, so the chuck shown was devised and proved both very handy and applicable to other shafts in the future. The castings were made 2 inches wide and tongued in the slot in milling machine table, and then milled in place for the shaft bearings. The taper-edged plates or clamps were made to reach the shafts with an angle of 45 degrees. These secured the shafts firmly and without spring and at the same time allowed the cutters to start at one end and traverse through to the other end without alteration. Four cutters, ground to a size and with packing adjusted to bring each central, completed the rig. By making another set of clamps longer and also a set shorter various sizes of shafts have been grooved. The chuck has also been used to advantage on single shafts which have had a collar on or a larger diameter in one part (which prohibited them from lying on the table) by placing short pieces of round bar in the side opposite for the clamps to pinch on. I don't know that there is anything very striking about this, but such things help machinists to produce work rapidly and correctly, and each

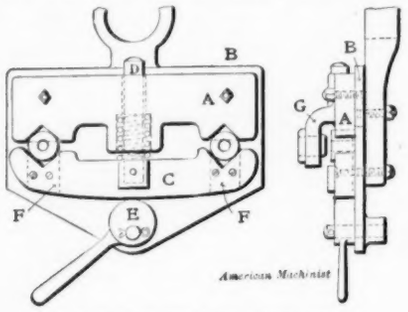
small wrinkle every week in the AMERICAN MACHINIST helps someone or another.

Shipley, York, England. C. M.

Two-Spindle Drill Press Jig.

Editor American Machinist:

I send a sketch of a jig—used in a two-spindle drill press—which does good work and does it quickly. The jaw *A* is bolted to the plate *B;* the movable jaw *C*, which



JIG FOR TWO-SPINDLE DRILL PRESS.

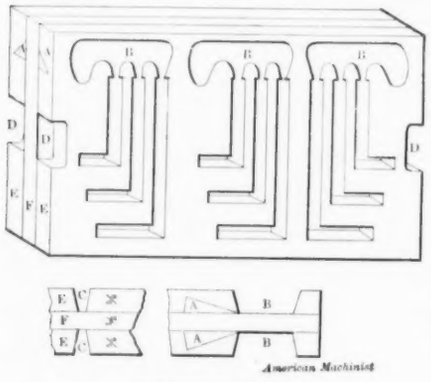
carries a pin running through *A*, is forced back by a compression spring when released by the eccentric clamp *E*. The flat plates *F*, on which the work rests, are screwed to the bottom of the jaw *C*. Two lugs *G* for the drill bushings (not shown in plan) are cast on jaw *A*. When in use, the jig is bolted to a bracket carried on the drill press column; the pieces to be drilled are placed on the plates *F*, and clamped fast by means of the eccentric *E*. After drilling, the jaw *C* is released and the work drops through a hole in the plate *B*.

E. M.

Making Gaggers for the Foundry.

Editor American Machinist:

There should always be plenty of gaggers of different sizes around a foundry, and the way we have made them for several years has proved very conclusively that you can save money even on the insignificant gagger. Instead of the old-fashioned



A MOLD FOR GAGGERS.

board with a few gagger patterns attached and two cleats on the back, we simply had a pattern made for a double mold, as shown, and from this pattern we had a dozen castings made.

The mold shows the gaggers on one side, three different sizes, three of each size on each side of the mold *E*. *E* is ⅝ inch thick each side, *F* is ½ inch thick. *B* is the runner, gated separately for each three gaggers. *A* is a taper piece inserted in the back of each side of *E*, so that the gagger will break off easily from gate *B*. *D* shows where *E* is cut out on each end to allow room for the hands in turning the mold over. The gates should be made good and large so that the metal will run freely.

In making the pattern, take two pieces of pine ⅝ inch thick, 15 inches wide and 24 inches long; lay out three sizes of gaggers, three of each size, as shown, with gates. Make the spaces for the gaggers 7-16 inch wide at the top and ¼ inch at the bottom, as shown at *C*. Cut to bevel on the jig saw, and also cut out on each end *D*. Mark out the second one from this and cut as before to the bevel and on the ends. Now cut out for the bevel piece *A* on the back and insert *A*, making it flush on the back. Sandpaper smooth; fasten one side *E* to *F* and fasten the other side with a couple of dowels, so that it will lift with the cope, and your pattern is finished.

Get good, smooth, clean castings for your molds and place each one in a level spot in different parts of the foundry. When pouring off, if you have any metal left in the ladle—not too cold—this will do for gaggers. It will also save the time required to go and empty the ladle. In ten minutes, or less, turn over your mold, throwing out those cast, and it is ready for immediate use. In ten minutes more turn it over again, and your mold is ready without any further preparation, and thus all the gaggers you need can be made in short order, at little cost and very expeditiously.

C. NEIL.

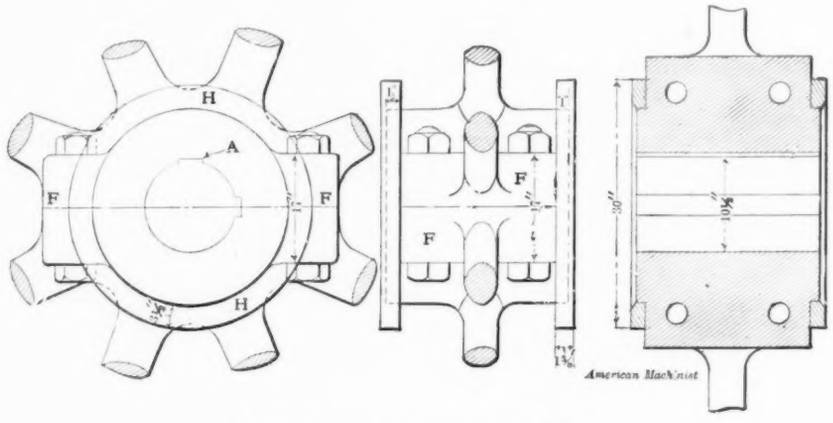
Repairing a Cracked Flywheel.

Editor American Machinist:

A few years ago while working in an engine shop in Yorkshire the boss sent me—then only just out of my apprenticeship—along with another workman about the same age, to a woolen mill a few miles away, where a flaw had developed in the flywheel of the mill engine in the shape of a crack in the boss, as shown at *A* in the sketch. Our instructions were to "hoop" the boss, as shown at both sides, with steel hoops. It looked a herculean task to begin on, but it was successfully acomplished in about eight days' time, and the wheel is running quite safely to-day. As it was a somewhat difficult job to perform—entirely by hand—and also a job not encountered very often, a few particulars as to how we proceeded may be of interest to some of your readers.

As will be seen from the sketches, the flywheel was cast in halves and secured by bolts passing through lugs projecting from each side of the boss, which had two keyways cut in, as shown. A crack had developed in the top keyway, as shown, and it extended across the boss in such a manner as to cause some uneasiness to the owners, who did not want to go to the expense of a new flywheel.

The bolt lugs *F* were cast flush with the face of the boss and were 17 inches wide, the boss being 23 inches diameter. We had to chip 1 inch off the edges of these



REPAIRING A CRACKED FLYWHEEL HUB.

lugs and finish off the boss here to their circle 23 inches diameter. It should be mentioned that we could not chip more than the 1 inch back on account of the nuts. The wheel ran along the side of the engine-house wall, so we had to sit in the wall box, about 24 inches high, to chip that side nearest to it. It was a tedious job, as we had to use a short-handled hammer, not being able to use an ordinary hammer on account of the wall box top. We got the chipping done, however, and a fairly true circle was made for the hoops, 23 inches diameter by 1 inch thick. Our next job was raising the flywheel and shaft, which together weighed about 24 tons. This we did with hydraulic jacks and packed the lot up with timbers under the flywheel rim. We then had to remove the crank to get the hoop on to that side of the boss, and to do this we used two large gas jets placed directly under the crank and coupled two air pipes to a small portable fan we had, turned by hand. We got the crank off all right and the hoops on, these in the meantime having been made and turned at the shop to gages

we made. It will be seen that the hoops were 1⅜ inches thick, although only 1 inch on the boss, the other ⅜ inch overhanging on the outside and beveled off, as shown in section. By this means we got them much stronger in sectional area. We gave the hoops plenty of "nip," allowing nearly 1-16 inch to shrink on, *i. e.*, making them 1-16 inch less in bore than the boss was in diameter. To get them on we had to get them red hot, but when they got on they soon closed and fastened themselves tight on the boss, which they held firmly, and thereby prevented the crack from going any farther. The job was a success in every way; since then the wheel has been speeded up 10 turns per minute, and is working quite safely.

Wigan, England. J. GREEN.

The Pattern Shop Trimmer.

Editor American Machinist:

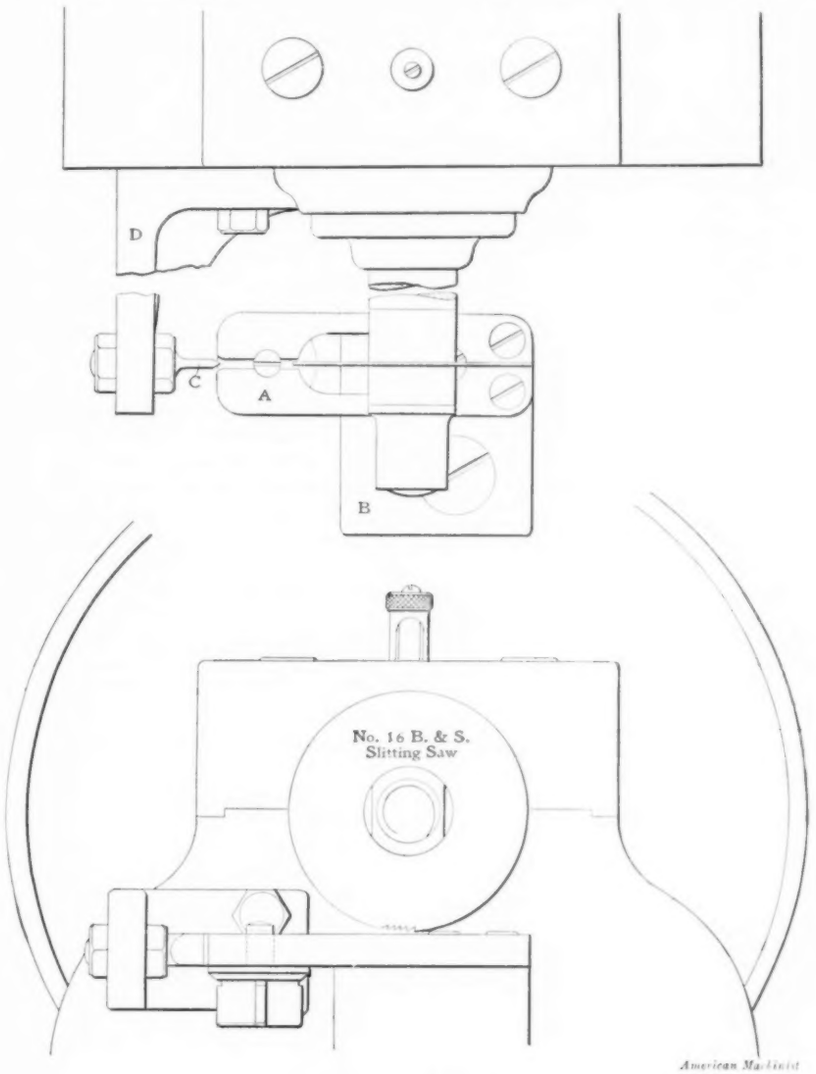
Not long ago I noticed an article in a mechanical journal on the "Shop Trimmer." It went on to tell "how handy a trimmer is in a shop where a number of patternmakers or other wood-workers are employed." Do I understand you to say, Mr. Journal, that *one* trimmer in a shop where there are more than three men employed is a convenience? In a shop where I was employed there were nine patternmakers and two trimmers. During a slack season five men were discharged, leaving four men and two trimmers in the shop. Each two men then took a trimmer and kept it in good order. Everything went well until one Monday morning the benches were filled with patternmakers, making nine in all again. Then the trouble started. The original four men thought they had a prior claim on the trimmers, and they undertook the job of convincing the new ones that they could use a hand axe or any old thing to do their fine trimming. The original four men would remove the handle when they were done using the trimmers, the new ones kicked to the foreman, who gave order "that all hands should have the use of the trimmers." The order was obeyed, and every man used the trimmer—as long as there was a piece of the edge left That settled the business; no one wanted to sharpen the knives, so they were put out of service. A trimmer is a handy tool in a shop when good care is taken of it, but to ask more than *two* men to use *one* simply puts it out of use. The same can be said of a glue pot; more than two men to use one glue pot simply puts the glue on the bum.

TRIMMER.

A Valve Slotting Jig.

Editor American Machinist:

This milling jig was designed for very rapid work on brass check valves with finished seats. These valves have to be handled carefully to avoid marring the seats or springing them out of true by any clamping device. The work is done on a hand feed milling machine, using the horizontal motion of the table. The parts are so arranged that as the table moves forward the valve is gripped before the saw strikes it and on the return motion the valve is automatically released. The operator feeds the valves into the holder with one hand and works the lever with the other. There is no lost motion or backlash on the part of the operator, and the quantity of valves slotted in a day makes the labor cost of the operation almost nothing per valve. The slot is similar to that in a wood screw head and is used during the grinding process.



A VALVE SLOTTING JIG.

Referring to the engraving, the part marked *A* is made of cast steel, the hole is bored to fit the valve stem and a slit ⅛ inch wide is sawed through to the larger opening in the center which gives the piece a better shape for springing. When the piece is heated up for hardening the sides are closed in until they almost touch, then it is hardened and drawn to a stiff spring temper. This piece is fastened by three machine screws to the cast-iron block *B*, which in turn is rigidly fastened to the table of the machine. The part *C*, of hardened steel with a wedge formed at the end, is fastened to the bracket *D* by two hexagon nuts. The hole in the bracket is oblong, parallel to the spindle, to make it easy to place the wedge in line with the saw. The bracket is fastened to the head of the milling machine by two cap screws. The cast-steel wedge is a trifle over ⅛ thick through the straight part, so as to open the spring enough to allow the valve stem to move freely in the hole. When the jig is set up in line with the saw and at the proper distance below it, the wedge is placed in line with the slot in the spring, the hand lever is locked in a convenient position for the operator, and the stop on the bed is set so as to allow the spring to straddle the wedge for about ⅜ inch. In this position the hole in the spring is slightly larger than the stem of the valve and the stem can be inserted without trouble. When the lever is moved over, carrying the jig along under the saw, the spring slides off from the wedge and closes up on the valve stem with a strong grip which holds it securely until the saw has made the slot and the jig

has returned to the wedge. As the spring straddles the wedge it allows the valve to drop out and the operation is completed.

ROGER HAINES.

Crankshaft Turning.

Editor American Machinist:

Turning a light, springy crankshaft and making good time is no fun unless you have special rigs for the work. The sketches show an arrangement that may be used for turning crankshafts of different throws and diameters within certain limits. Fig. 1 shows one of two pieces that fit the ends of the shaft and which bear the centers for turning the pins. It is bored the size of the end of the largest shaft when roughed down, is split and two strong bolts are used to tighten it in place on the shaft. The face *E* is grooved, the center line of the groove *C* passing through the center of the hole *D*. Face *G* is placed perpendicular to this groove, both pieces being of the same length or the same distance from center *D*. Piece *A* fits into groove *C* and is held in place by two bolts, as shown. It is bored to receive center *H*, of hardened tool steel. Face *E* is graduated as shown, and the center carrying piece *A* can be set at the distance from center *D* corresponding to the throw of the crank to be turned. Split bushings are to be made for *D* for different sizes.

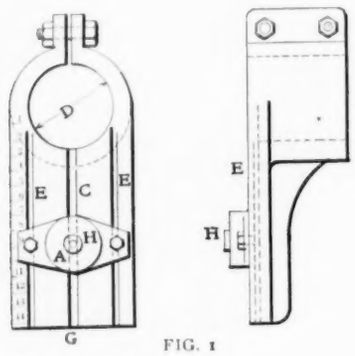


FIG. 1

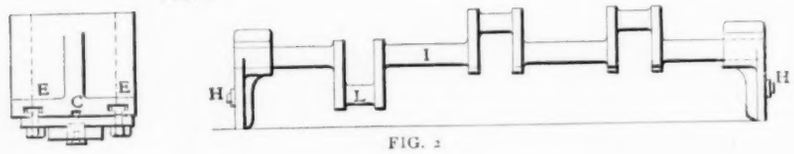


FIG. 2

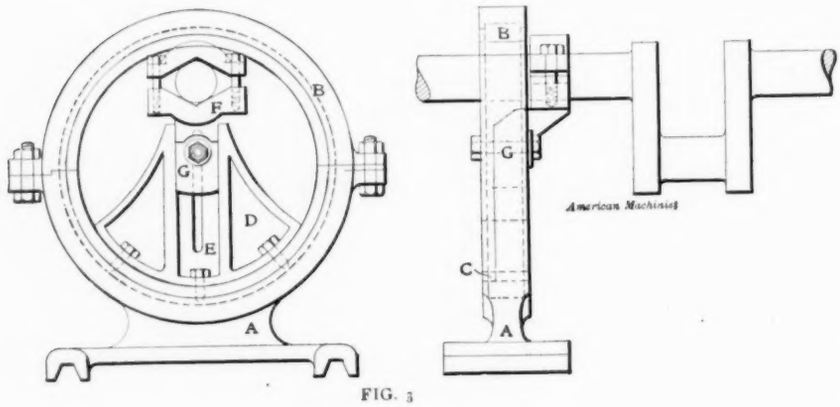


FIG. 3

CRANKSHAFT TURNING.

Crankshafts are generally roughly forged, and there is a great deal of material to be turned off, and a center rest is necessary. Fig. 3 is adapted for shafts of different throws and diameters. It consists of a bearing *A* for piece *B*, which is grooved at *C* to receive piece *D*, the latter secured in place by three bolts. *D* is planed at *E* to receive sliding piece *F*, which is tightened in place by bolt *G*.

The bearings of the crankshaft are roughed first and the outsides of the webs are faced. The two pieces, Fig. 1, are put in place at the ends of the shaft, and the shaft is put on a true plate, as shown in Fig. 2. The shaft is then rotated in the pieces until the centers *H H*, previously set to the right throw, correspond with the centers of the crank-pin *L*, and then the pieces are tightened. The centers of the pins were of course laid out previously. The shaft is then put in the lathe, and the center rest, with pieces *D* and F, removed, is put in place. *D* is then screwed on to *B* and the latter is turned until the V-block *F* fits the journal of the shaft at *I*, Fig. 2. The top of the V-block is then bolted in place, and bolt *G* finally secures *F* on *D*. Weights are bolted on the face plate to balance the crankshaft.

With this arrangement heavy cuts can be taken, and two tools may be used to face the insides of the pin webs. When the first pin is roughed down the shaft has to be put on the plate again and turned in the end pieces until the center of the next pin corresponds to centers *H H*. This is repeated until the crank-pins are all roughed down. After this the edges of the webs are planed to the right size, and then the shaft is finished, repeating the operations described. It is good practice to finish the crank-pins first and then the journals.

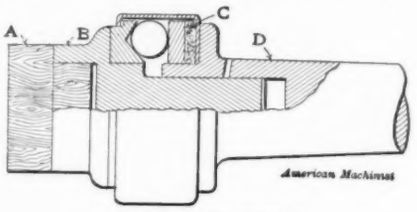
JOSEPH MENEGUS.

Ball Bearing Center.

Editor American Machinist:

The ball-bearing center shown herewith is used in the tailstock of a metal-spinning lathe. The usual way of holding the metal against the form, screwed to the headstock spindle, is to have a small block of wood inserted between the metal disk and the tailstock center, the wood turning upon the center. In spite of the oil and graphite used, the friction is so great at times as to cause the wood to smoke, and to heat the center and spindle so hot that the hand cannot be held upon them. This causes a great deal of inconvenience and loss of time in cooling the center.

In the sketch is shown a thrust bearing such as is used on the propeller shaft of small launches, and which may be bought upon the market in a number of sizes, assembled in a brass casing ready for use.



BALL-BEARING CENTER.

A is a block of wood which is brought to gear against the metal to be spun; this wood is held in a phosphor bronze stem *B*, which is fitted into one of the rings of the thrust bearing, and runs loosely in the taper shank *D* fitted to the tailstock spindle.

The other ring of this bearing is a tight fit on the front of the taper shank. This arrangement is for the purpose of keeping the bearing in line, and preventing the steel ring from rubbing against the brass casing.

The piece *B* may be omitted if desired and the block of wood inserted directly in the V-ring, but it will not always run true this way.

C is a felt washer inserted between the hardened ring and the brass casing, making the bearing self-alining and preventing undue pressure upon the balls due to the crowding of the metal between the form and the block of wood during the spinning process.

S. B.

A "Barber Shop" Tool Arrangement.

Editor American Machinist:

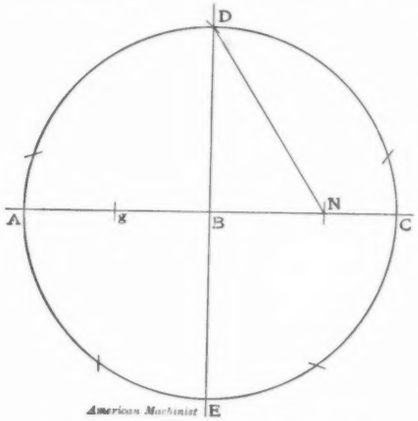
While traveling through a few of the large cities in the South one of the many good mechanical things I saw was in the wood-working department of a large machinery manufacturing company, and I could not help naming it "The Barber Shop." The general wood-working—patternmaking, carpentering, etc.—was done in this department. The workmen were very much scattered, while the wood-turning lathes were in a bunch at one end of the shop. I noticed that the workmen at the lathes had a good variety of handy

turning tools. A common practice in a number of shops that I have worked in is for the workmen to have a small box in which the turning tools were kept, and when a job of turning was to be done the box was carried to the lathe, and nine times out of ten with the tools you did not want, and about five or six trips to the bench would be necessary to get all the tools wanted. In "The Barber Shop" a large case was made by the firm, and in this case were about fifteen drawers with locks. Each man was given a key to a drawer in which all his turning tools were kept. The workmen explained to me the system and said it was a pleasure when a tool was wanted to get at it so handily and quickly, instead of diving down in the bottom of a tool box half a mile from the lathe. SALESMAN.

Dividing the Circle.

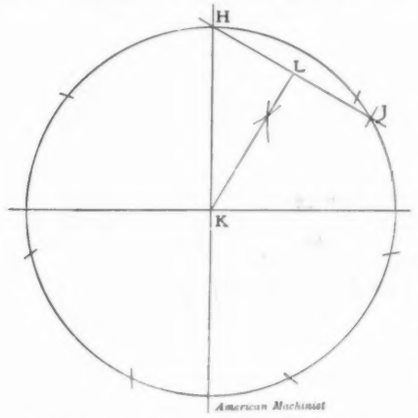
Editor American Machinist:

Of course, we all know how to divide the circumference of a circle into 3, 4 or



TO DIVIDE A CIRCLE INTO FIVE PARTS.

6 equal parts; but how many can divide it into 5 or 7 without trial spacing? To divide into 5 parts, Fig. 1, draw the diameters AC and DE perpendicular to each other. Bisect the radius AB at G. Set



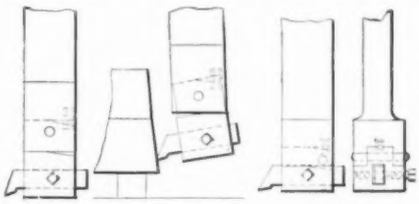
TO DIVIDE A CIRCLE INTO SEVEN PARTS.

the dividers at G and strike $GN = GD$, and DN is the distance required. To divide into 7 parts, Fig. 2, let $HJ = HK$; bisect HJ at L, then KL is the distance required, very nearly. J. P. APPLEBY.

The Hang of the Slotting Tool Holder.

Editor American Machinist:

Seeing in a large shop several slotter tool posts in use of a very poor design prompts me to call attention to their faults for the benefit of toolmakers or others who may have thoughts of making something of the kind. These tool posts were as shown in the sketch at 1. The pin is not placed



THE HANG OF THE SLOTTING TOOL HOLDER.

in the proper position. A man familiar with the working of these tools says that at times they were the most horrid things he ever had dealings with, all on this account. In taking a cut down a surface, as at 2, the forgings often coming thus, the nose of the tool would skate off over the surface until some slight projection would catch the point of the tool and then there would be a wreck, sometimes broken bolts, then the tools, and again the crank pin would go. The design as at 3 is very much superior, and with that the tool would not refuse the chip.

FRANK RATTEK.

Lazy Men and Overworked Men.

Editor American Machinist:

In reading the amusing article of your genial contributor, Mr. Osborne, on "Who is the Lazy Man?" at page 945, certain old-time memories and reminiscences occurred to me apropos of the subject. During one of my sojourns in Cleveland, Ohio, a young man told me that he had "an awful responsibility" upon him. "I sometimes wonder how even I stand it; it is awful," with much more of the like nature. I subsequently ascertained that his work was re-tapping small holes that had been improperly done or missed altogether, in parts of sewing machines and in sufficient quantity to serve several assemblers.

Another case was that of the principal of a machine shop ordinarily employing upwards of 2,000 hands. Long after retiring from active participation in the management, when his legislative duties would permit, he would occasionally pay a visit to the works. On one of these occasions the managing partners requested his advice regarding the appointment of a foreman. One favored a lathe hand, while the other favored a floor hand. The great man said: "When you want to appoint a foreman and have a good man at a machine or a vise, keep him there; it is better for him and better for you; any damfool will do for a foreman."

That seems to be an opinion widely held, judging from observation, and the lack of good and intelligent material available. The complainants fail to recognize the fact that a "damfool" foreman implies a "damfool" management. I. W. P.

Making a Special Screw.

Editor American Machinist:

In the photograph, Fig. 1, is shown a special screw and the chuck used for holding it while the head is being rounded. The body of the screw is ¼ inch in diameter by ¼ inch long and the head is ⅝ inch in diameter. The screw is made from ⅝-inch brass rod and is severed from the bar with a parting tool that leaves the head flat and makes a second operation necessary.

Having no screw machine available, we

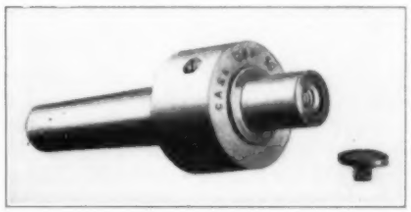


FIG. 1. SPECIAL SCREW CHUCK.

use a small engine lathe for this work. To make a suitable chuck to hold the screw by the short thread somewhat puzzled the writer until this device, which is shown in section in Fig. 2, suggested itself.

The body A is turned with a taper shank

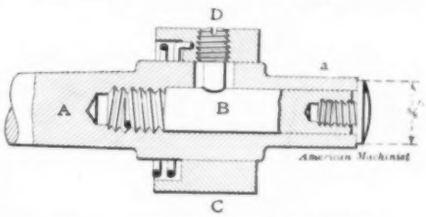


FIG. 2. SECTION THROUGH CHUCK.

to fit the lathe. It is bored and threaded, as shown, to receive the plug B, which is itself bored and threaded to receive the screw. C is a free-fitting collar on A and is connected to B by the headless screw D working in a transverse slot extending

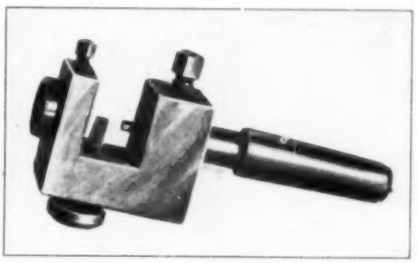


FIG. 3. ROUNDING TOOL.

about half way around A. A spiral spring in the counterbored part of C holds B in its normal position—that is, with its outer end a little inside of the outer end of A.

A screw is chucked by holding it to the threaded opening while the lathe is run-

ning. The head is then rounded, the lathe is reversed, and the collar *C* grasped with sufficient friction to overcome the spring, thereby screwing *B* slightly forward; at the same time a slight pressure on the screw with the other hand readily withdraws it from the chuck.

It may be observed that the thread on the inner end of *B* must be of a coarser pitch than that on the screw. Someone might suggest putting a left-hand thread on *B*, but in that case the lathe would have to be stopped to take out the screw.

All the parts are tool steel except the collar *C*, which is machine steel. The nose *a* is hardened and ground to fit the 11-16 inch bushing in the rounding tool, Fig. 3, which I think explains itself. This combination is very rigid, and with a well-stoned cutter produces a nice finish.

This same tool with a 5/8-inch bushing, and a different cutter, does the previous operation of turning down the screw. The small plug which protrudes from the shank is a stop for gaging the length under the head, and is adjusted by sliding the frame of the tool on the shank.

H. B. McCABE.

Loam Patterns for Special Pipes.

Editor American Machinist:

There are several methods employed in making loam patterns for the molder's use. Such patterns for special pipes are usually

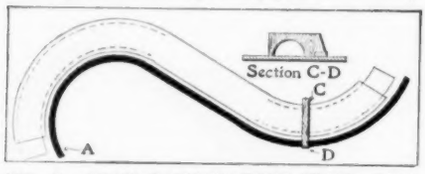


FIG. 1. LOAM PATTERN WITH PLATE, TEMPLET AND GUIDE.

required to be used but once and plates or special rigging wanted should be reduced to the smallest possible amount. One method which appears to be generally followed is to prepare a wood templet a little larger than the pipe wanted, and cast two plates on which the loam pattern is swept. The core is first made, and after drying a thickness of loam corresponding to the thickness of the pipe is swept on

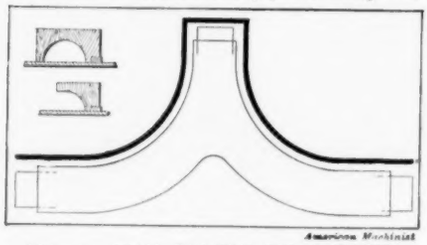


FIG. 2. LOAM PATTERN FOR A Y-PIPE.

the core and also dried, the loam pattern being then ready for the molder. This method gives good results, and was used by the writer for some considerable time, but, having always a considerable number of special pipes to make, the wood templets and the plates on which the patterns are swept accumulated at rather a rapid rate, and as it is very rarely that orders for these pipes repeat themselves exactly, the plates were found to be of very little service and it was necessary to break up several tons of them every few months, and finally they were scrapped as soon as the castings for which they were made left the fettling shop.

The means employed at the present time give results equal to the above, with the following advantages: No special wood templet is required and no special plates are cast, the ordinary stock plates generally used in the shop supplying this want perfectly. Fig. 1 is a plan of a plate having the loam pattern of a special pipe swept on its face. The heavy line *A* represents a bar of iron bent to the pipe shape and used as a sweep guide. When making patterns by this method the patternmaker lays the pipe out full size on a suitable board. He also sets a line 1 inch from the outside of the pipe following its contour the full length of the pipe with an allowance of some inches for prints at each end. This board is sent to the smith who bends the iron, as shown on Fig. 1.

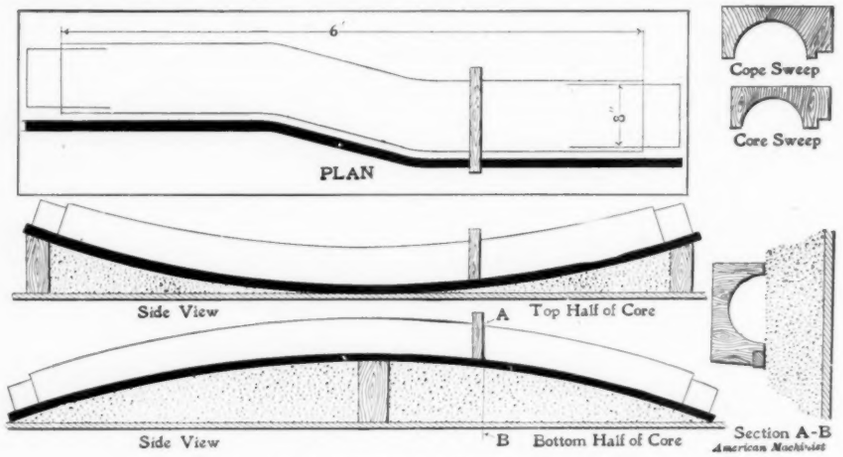


FIG. 3. LOAM PATTERN FOR SPECIAL CURVED PIPE.

The board is next returned to the patternmaker who fastens flanges or sockets on the board. The molder places one-half of the loam pattern on the board and rams up his drag; or if the pipe is bedded in the floor, he digs holes to let the flanges into the floor and places the board, the flanges being on the under side, on the prepared bed. After ramming up around the flanges, which usually come close to the outside edges of the board, the screws which secure the board to the flanges are removed and the board is lifted off, leaving the flange correctly set in the floor. The loam pattern is then set into the necks of the flanges. With many small patterns the half-loam pattern may be fixed on the board, and with the flanges holding it in its place the whole may be rolled over and bedded into the floor.

Fig. 2 is a plan of a plate with a tee-

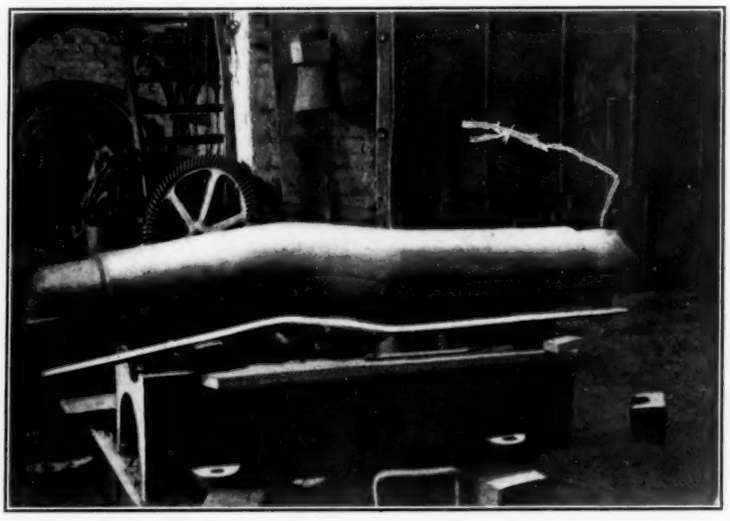


FIG. 4. A LOAM PATTERN READY FOR MOLDING.

pipe loam pattern swept on its face, the heavy line representing the sweep guide, as in Fig. 1. It will be seen that by this method all the special tackle which is wanted for the making of any loam pattern is the piece of wrought iron bent to the shape. The time taken by the smith does

not average one hour for each piece bent, and there is very little waste of material, as the iron guide used for some former pipes are often re-bent to suit present requirements. The method is also suitable for the making of loam patterns of almost any shape, thus having a greater scope than any other plan, besides the advantage of simplicity and cheapness.

Fig. 3 gives a plan and side views of a loam pattern for another pipe, which shows the usefulness of this method for a large variety of shapes. When preparing the iron guide for this pattern, the piece was bent, as in the plan, and afterwards to a line, as in the side views. When sweeping up this pattern the iron guide is first propped up at each end with a piece of timber and a sand bed is made. The iron guide is worked to and fro on the timbers, thus forming a bed on which the loam pattern is swept. The first half having been finished off, the iron guide is reversed and with a timber under its center, as in the third view of Fig. 3, the bed is again formed and the other loam half-pattern is swept. It is to be understood that in the examples here given the core is first swept and dried and the pipe thickness is then swept on. If more than one casting is wanted, the pattern is made as stated, but additional cores only are swept, the pattern first made being used for as many molds as are required, and then stripped of its thickness and used as a core.

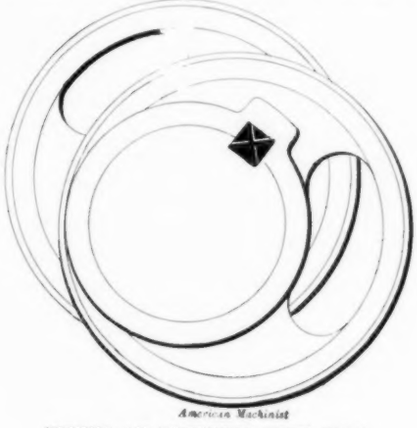
The half-tone, Fig. 4, is a view of the loam pattern and sweep guide, as in the sketches at Fig. 3. The pattern as shown is ready for the molders' use.

GEORGE BUCHANAN.

An Eccentric Keyed With Wire Nails.

Editor American Machinist:

I was ordered the other day to go twenty miles up the lake shore to "fix up" a marine engine in a yacht and bring it (the yacht) back by the next night at the latest. The engineer was to have the crank shaft out ready for me to babbitt the boxes. I did as I was told to and everything went fine till I came to the eccentrics. The engineer had removed them to make my work easy, but in doing so he lost the key that held them to the shaft, and after a two-hour hunt we concluded it was not aboard. The best substitute I could find was four 20-penny wire nails. I cut them off and fitted them to drive diagonally across the keyseat, as in the sketch, driving one one way and the next the other way, and so on till the keyseat was full. We got home on time and made a new key. I considered it a fair makeshift, for the eccentrics showed no signs that they had moved a bit. MAC.

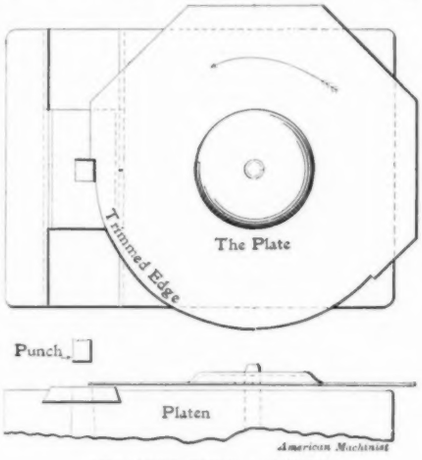


KEYING AN ECCENTRIC WITH WIRE.

Circular Shearing with a Punch.

Editor American Machinist:

An illustration of the advantageous, though unusual, use of a power punch was recently noticed and is here recorded. The job consisted in trimming sheet steel disks from square plates, the corners only having been sheared off previously. The plates were about 3-16 inch thick and 16 inches diameter, with a depression in the middle, having a ¾ hole through it. When a few dozen only were to be trimmed, a lathe fixture had been used, holding two at once; more could not well be clamped on account of the central offset. The lathe process was very slow and tiresome, hard on the tool and requiring some skill in the operator. Somebody suggested the use of a power punch and rigged up a plate with a stud fitting the central hole; an old punch and die was used, having a straight side, about 1 inch long, next to the edge of the disk.



SHEARING WITH A PUNCH.

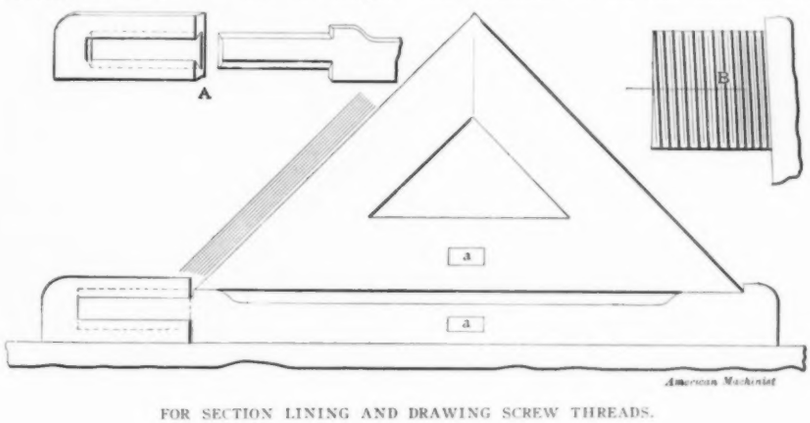
By hand feeding, or rather turning, the disk slowly on the pin, letting it rest on the die and supporting plate, and keeping it from rising by a stripper (not shown), the press being in constant action, the disks are now trimmed one at a time at an average rate of two minutes each, or about the same time as it had previously taken to clamp them in the lathe fixture. As the edges do not require any special finish, beyond a moderate limit in size, the small flats resulting are negligible. Obviously, a better job could be obtained by the use of better adapted tools. The numbers used are now up in the thousands, so it will be seen that a very considerable saving has been accomplished by a simple expedient in press working. W.

Device for Drawing Screw Threads and Section Lining.

Editor American Machinist:

Many of your readers will undoubtedly recognize this section liner as something not new. While this is perfectly correct, it does not detract any from its merit. I have been using one for a number of years, having whittled it out of a piece of pear wood on first entering the drawing room. Its use has been principally for hatching, but recently having occasion to show quite a number of screw threads in drawings of Prof. Rowland's ruling engine, it occurred to me to adopt it for that purpose. With the aid of this device no previous laying off is necessary and a correct inking is assured at once.

The sketch shows the manner of using the section liner. The main slide is adjusted (see *A*) with regard to the distance between the section lines, and is placed in contact with the edge of a T-square, as shown. Recesses *a* in the main slide and in the triangle are for the thumb and forefinger of the left hand, and by sliding or shifting first one and then the other, the triangle is caused to step off equidistant lines, which may be drawn in pencil or ink. *B* shows the manner of indicating screw threads in a conventional way, though it may be done just as read-



FOR SECTION LINING AND DRAWING SCREW THREADS.

ily if full threads, showing the V's are required.

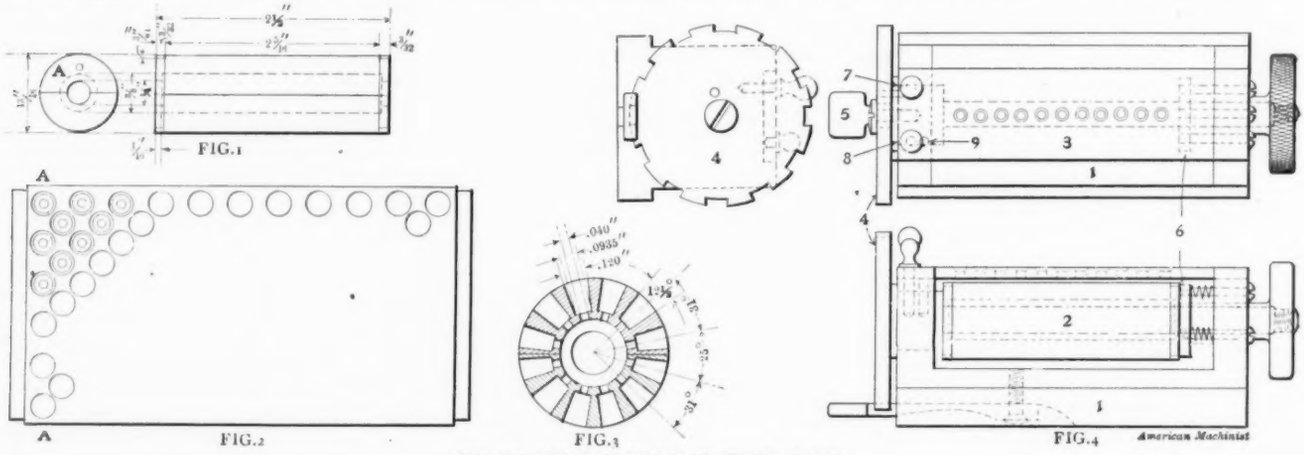
In using one of the short sides of the triangle I have made a second slide to suit it. There is no patent on this device and anyone who will devote half an hour or so to making one will never regret it.

EDWARD A. OSSE.

Jig for Drilling Circular Brush Cores.

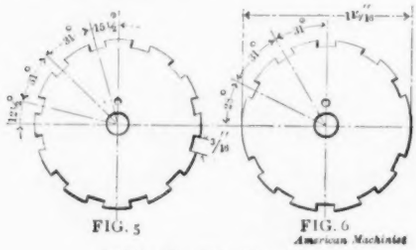
Editor American Machinist:

Some time ago we had to make some brass cores for small circular brushes. The holes for the insertion of the bristles were required to be very close together, and I have thought that the means adopted for drilling might prove of interest to some of your young readers; possibly to some of the older ones also.



JIG FOR DRILLING CIRCULAR BRUSH CORES.

In the drawings sent herewith, Fig. 1 shows the blank core. It is made in halves and is held together by a ring on either end. At *A* a small hole was drilled for the purpose of locating and holding the blank in the drill jig. Fig. 2, drawn to a larger scale, represents the developed surface of one-half of the core. Fig. 3 is a section through the core taken on the line *A A*, Fig. 2. Fig. 4 shows the jig for drilling, and Figs. 5 and 6 the two index plates for the same. Fig. 5 is used for the rows of eleven holes and Fig. 6 for the rows of ten holes.



INDEX PLATES FOR JIGS.

In Fig. 4, 1 is the body of the jig, 2 the shaft for holding the cores, 3 the hardened guide plate, 4 the index plate, 5 a spring catch, 6 a spring collar, 7 a pin to locate the guide plate, 8 a dummy pin, 9 a hole for pin 7 when the plate is in the second position.

In the operation the knurled nut on the end of the shaft 2 is unscrewed and the shaft withdrawn, pin 7 removed and plate 3 lifted off. The blank is then held approximately in position and the shaft 2 inserted, entering the small dowel pin on the shoulder of the shaft in hole *A*, Fig. 1. The knurled nut is then screwed on the end of the shaft. When down to the shoulder it allows the shaft to turn freely but without end shake. The collar 6 is pressed by the springs against the end of the blank and holds it against the shoulder of the shaft. The guide plate is then replaced and pin 7 inserted in the position shown.

A No. 42 drill is used first (that being the size of the guide plate holes) and set so as to go to the proper depth to form the shoulder shown in Fig. 3. When one row of holes is drilled, the No. 60 holes at the bottom are drilled through with a drill held in a second spindle of the drill press; the spring 5 is then pressed down and the work rotated to the next position. All the blanks having been operated on in this manner, the index wheel 5 is removed and replaced by No. 6; pin 7 is removed and replaced by the dummy pin 8. The only purpose of the latter is to prevent pin 7 being inserted in the wrong hole. Pin 7 is then placed in the hole from which pin 8 was removed and the plate 3 moved endwise until the pin enters the hole 9. In this position the last hole in the plate is not needed, so a pin is inserted to prevent it being used by mistake. The blanks were all drilled in the manner described.

In the final operation, reaming to 12½ degrees taper, the blanks were held in the jig and indexed in the same manner, the guide plate being removed. This made it necessary to change the index plates for each piece, but as the number made was small it was not a great item. Had there been any considerable quantity I should have made a third index plate combining the positions of both 5 and 6.

J. A. WEBSTER.

To Prevent the Mixing Up of Lathe Centers.

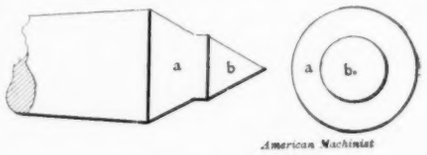
Editor American Machinist:

Many of us have undoubtedly wished for some fitting punishment for the man, who, after finishing a chucking job in a lathe, puts the live center in the tail spindle. How often we see both centers in such a condition that accurate work is an impossibility!

When a live center has been carefully ground and marked so that it can be returned to its proper position in the live spindle, it should stay in good condition for months. Of course, this does not apply when some job of extreme accuracy is in hand; the live center must be trued up for such an operation, regardless of its appearance. On the other hand, the dead center is subject to rapid wear, and must, or should be, often re-ground.

This changing of centers is particularly disastrous when, as is still the practice in some shops, the live center is left soft. There seems to be no excuse for this, however, for a dollar or two a year (interest on investment) will furnish a first-class center grinder.

After several flagrant examples of this center-changing habit, it occurred to me that it might be prevented to a large extent by making the centers so radically different in shape and color that mixing them up could only be due to criminal carelessness. The dead centers on several lathes were changed as shown in the sketch, *a* being left black and the projecting portion *b* ground. The corner of the tool which forms the cylinder between *a* and *b* should be slightly rounded. The dead centers, which need frequent grinding, are more quickly trued up, and, if the cutting back at *a* is not overdone, the center is not weakened to any appreciable extent. The distinction between live and dead centers is now so marked that the man who mistakes one for the other is at once accused of color blindness and kindred failings.



DEAD CENTER.

This scheme may be old to many, but it was new to several machinists of my acquaintance, and I send it to you with the hope that it may influence others to send in similar shop-kinks which will probably be new to me. F. W. T.

An Inside Micrometer as a Hight Gage.

Editor American Machinist:

It is very convenient sometimes to take the ideas of others and convert them into something for our own benefit. The accompanying sketch and photographs will show how a young toolmaker of the prog-

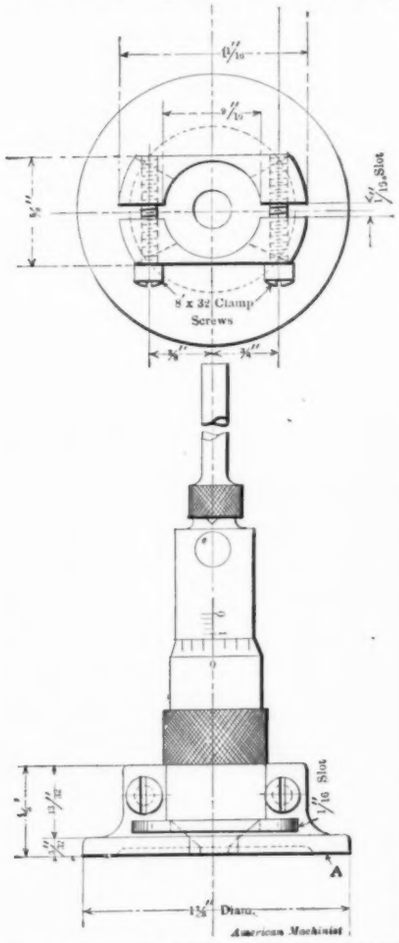


FIG. 1. AN INSIDE MICROMETER AS A HIGHT GAGE.

ressive sort with an ingenious turn of mind, makes a very respectable hight gage from a set of micrometer gages made by one of the standard machinists' tool making firms.

It is possible that several other machinists and toolmakers have had their "thinking caps" on, and have evolved the same improvement—that is, the attaching of the base piece to the caliper gage.

The attachment consists principally of the little steel flanged clamp base, turned from a piece of cold rolled steel, as shown in Fig. 1. The top view shows the micrometer removed. The base is bored to fit the head, and the two clamp screws may be tightened, making the whole very firm.

In the construction of the piece, the bottom surface A is faced off true, to allow the small point on the end of the micrometer to stop flush with it, so that the conditions in measuring hights will be exactly the same and the measurements will be taken from the same point as in the calipering of lengths or inside diameters, for which the gages were originally intended.

The elevation sketch gives the gage set to a hight of 3⅝ inches. Any fractional part of inches may be taken by the extension rods, giving hights from 2 to 12½ inches, and longer rods might be safely used.

The photograph, Fig. 2, illustrates the gage as used in setting a planer tool to hight. In Fig. 3 the camera gives an idea of the hight gage as applied to the setting of the surface gage for locating a center line on the face of a lug 12 inches above the base of the casting, which rests on a large face plate. It will be observed that our toolmaker has again "shown himself" by the arrangement of the sliding beam *B* on the upright rod of his surface gage.

The accuracy of the results obtained by

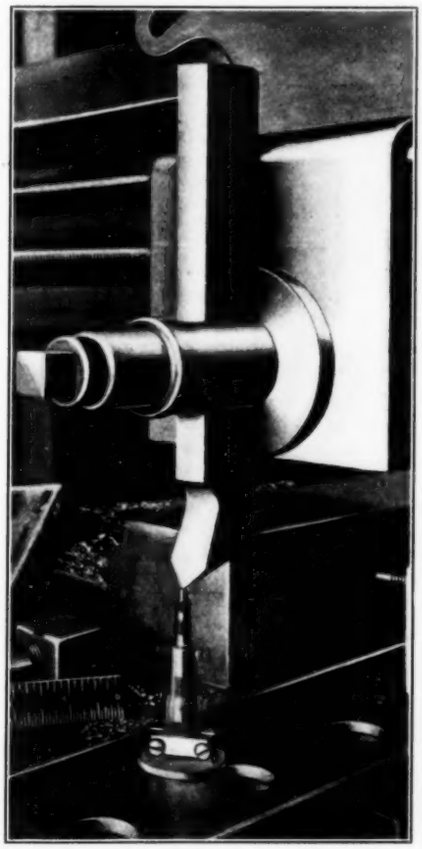


FIG. 2. SETTING A PLANER TOOL.

means of the gage when used as shown in the photographs, and in several other practical tests, shows the skill of the men employed in the manufacture of the micrometer caliper with its interchangeable rods. D. E. MacCarthy.

Cooling Drinking Water.

Editor American Machinist:

In my cub days I held the important position of ice-water doctor during the hot months, and I remember the ill-smelling mess swimming around in the ice water cooler when I took off the cover to fix the coming day's supply of ice water for the shop. The iceman would leave his

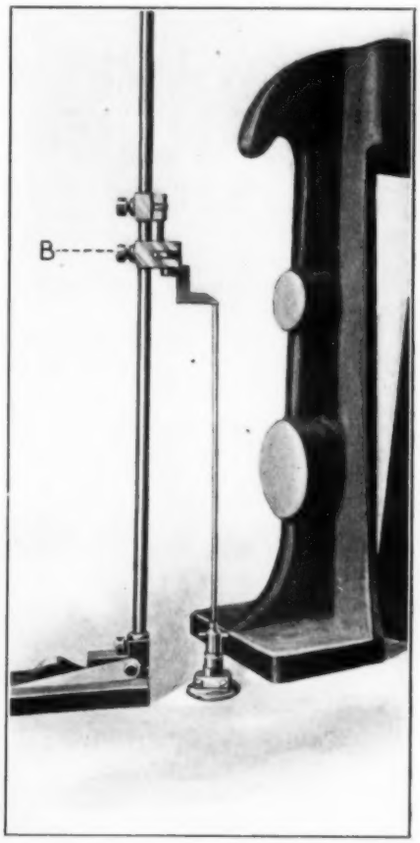


FIG. 3. SETTING A SURFACE GAGE.

five or ten cent piece on the dirty shop floor. I would stop my monitor, or whatever it happened to be, wipe my hands with a piece of waste and put the ice under the hydrant, let some water run over the upper surfaces and finally throw it in the cooler. A package of oatmeal added and the whole thing stirred with a piece of wood, I would resume my work laboring under the solemn conviction of having benefited mankind in general once more. Since I never liked washing dishes, I was not very particular about getting all the old oatmeal out of the corners, and if nobody happened to be looking my way and I was working on a particularly interesting job, I would simplify matters considerably by just throwing in the fresh piece of ice and letting well enough alone. This was not exactly the way mother did it, but it was the quickest way of getting rid of a disagreeable job, that did not lie in my line of business anyway.

It is possible to make a simple arrangement for cooling the drinking water without mixing the melting ice with it, and

without any necessity for the oatmeal, at least for sanitary reasons. Place in the tank a coil of pipe as large in diameter as will set in it comfortably, leading the water into the pipe at the side of the tank near the top and out of the pipe at the bottom of the tank. Break up the ice and put that alone into the tank. A faucet should be provided at the bottom of the tank to draw off the water from the ice as it melts. Where the water supply connects with the coil if there is placed a tee in the pipe outside the tank, and if a faucet is placed in the branch of the tee, uncooled water may be drawn as required without interfering with the drawing of the cooled water. The cooled water is of course drawn from a faucet at the lower end of the coil where comes out of the tank.

FRANK GREINER.

Ball Caliper for Measuring Thread Pitches.

Editor American Machinist:

The accompanying photograph shows a very handy instrument for measuring the pitches of threads to a high degree of accuracy. We use it very successfully in our tap-making department. It consists of the well-known vernier caliper of Brown & Sharpe's make that measures on one side to 0.02 millimeter and on the other one to 0.001 inch. The measuring points are balls, as shown, these being adopted because the centers always indicate the middle of any angle whatever it may be. We always measure over a number of threads, say 10, because the error is thus multiplied and is more easily discovered.

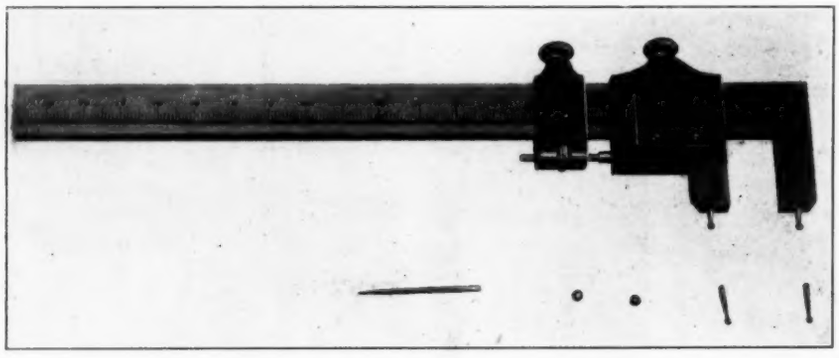


FIG. 1. BALL CALIPER FOR MEASURING THREAD PITCHES.

The letters *b*, *c* and *d* show the three different sizes of balls for pitches of .55 to 7 millimeters. Balls *b* and *d* are mounted on pivots *a*, but balls *c* are made in one piece with pivot; *e* is a needle for lifting the balls. To provide easy reading we so locate the holes for the pivots that the smallest reading on the vernier will be 10 millimeters, and if, for instance, the vernier indicates 50 millimeters, the true reading between centers of balls is 40 millimeters. When measured, the taps are put between lathe centers. The sketch, Fig. 2, shows the method of applying the instrument to a screw.

OTTO ECKETT YUGEN.

Berlin, Germany.

[An instrument of this sort would certainly be very useful. We must say, however, that we fail to see the reason for making the balls separate from their supports, while there seem to be excellent reasons for making them in one piece. It is also clear that means are necessary to insure parallelism between the center line joining the two balls and the center line of the screw being measured.—Ed.]

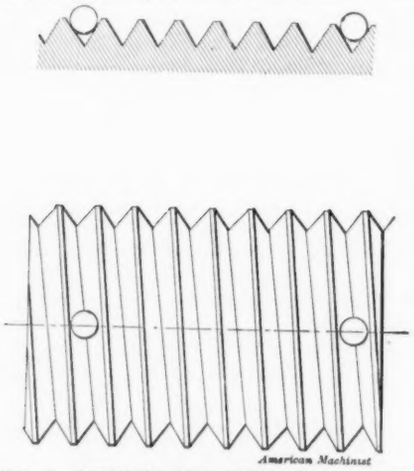


FIG. 2. APPLYING BALL POINTS TO A SCREW.

Making Close Running Fits—Cutting Threads.

Editor American Machinist:

In this letter I submit a few suggestions which I have never seen in print and which might be of value to others. No. 1 is a kink that I picked up from the instrument makers, the knowledge of which has set my heart rejoicing more than once. It is all about fits; snug fits, tight fits, easy fits and almost any kind of a fit may be obtained on any character of work without any trouble or uncertainty. The secret of the whole matter is simply a little pumice and oil rubbed on the parts to be fitted. For instance, it is desired to get a very smooth working fit between a hardened screw and its nut. Since both are hard they cannot be touched by anything but emery, and emery, as my brother toolmakers will admit, is to be steered clear of, if anything is to stay a fit. A very small quantity of pumice with plenty of oil, while the screw is being worked in and out by hand until all the tight places are eased up and until the desired fit is obtained, will make the otherwise very disagreeable task of fitting seem easy.

Another example: Let it be desired to fit a cast-iron part. While emery sticks in the porous metal, and can never be gotten out again, the pumice stone acts in a much gentler manner and can be cleaned off with benzine, so that no trace of it will be left.

When fitting a slide, it is hardly necessary to use a scraper, as the rapidly cutting powder will take away the high spots in an astonishingly short time.

It becomes necessary at times to cut a multiple thread on a small job, and the size of the job, or rather the smallness of it, hardly warrants the trouble. In such cases I have found the following makeshift a very useful one. Let us say a short triple thread, 10 to the inch, is wanted. I take a 30-threads-to-the-inch chaser and clamp it in the toolpost, set the gears for 10 threads to the inch, and the result is a 10-to-the-inch triple thread. If a double thread 12 to the inch is desired, the gears are set for 12 threads and a 24 chaser is clamped in the tool-post. While the foregoing method, of course, can hardly be used in making a tap, it nevertheless works well enough in most cases.

We have read a good deal lately about catching the thread in simple screw cutting, and to the many suggestions in that direction I would like to add this one, which I picked up in my apprentice days from a toolmaker who knew how to do things, and which, because of its simplicity, may shed more light on the subject for the benefit of those who are still in the dark. After running the first cut down to its full length, the lathe is stopped and a chalk mark put on the upper side of the chuck or face-plate. Then the length of the thread is measured. Let us say the thread is 2¼ inches long. Then a scale is laid on the lathe bed, against the end of the carriage and 3 inches marked off on the lathe bed with a piece of chalk or a pencil. Unless the thread is cut close to a shoulder, I hardly ever find it necessary to stop the lathe. When the thread has run its length, the tool is withdrawn with the left hand and the nut is drawn out of the lead-screw thread with the right hand. The carriage is then run back by hand until its end is right over the chalk or pencil mark on the lathe bed and then the lead screw is engaged for a new cut. When a boy, I once got a job in a shop, where they stuck to old methods very closely. In this shop a good many square threaded lead screws for woodworking machines were cut, and no one seemed to know this or any other trick for running the carriage back by hand. One day the foreman—who, by the way, did not know it either—gave the man alongside of me an order for a dozen lead screws about 30 inches long. As they were in a great hurry for these screws, the lathe hand, a very chesty fel-

low, who made it his business to boss and abuse me a good deal, suggested to the foreman that that "kid' might probably be able to help along, and on my assurance that I had cut threads before, six of the screws were unloaded on my shoulders. He had the best of me while the turning down went on, but when I finally got my threading tool in position the tables soon turned and I got my screws done a good deal sooner than he did. It never occurred to that man to ask for information, and I had learned by that time that instructing your betters is always poor policy. In the year and a half that I worked in that shop I cut most of the larger screws, and everybody made it his business to look the other way when that simple trick was in operation, and no one ever bothered me for the information that I was just dying to give.

There is another simple trick connected with screw cutting, which has helped me a good deal. When a coarse thread has to be cut on a lathe without compound rest, the tool has to be tapped from one side to the other in order to take any kind of a cut, as the chips will crowd, to the detriment of the point, and frequent grinding as well as setting is the result. I have found that alternately pushing and holding back the carriage handle while cutting, causes the tool to cut on one side only of the thread, and the tool lasts much longer. If a compound rest is available, however, the tool can be made to cut on one side of the thread without any trouble.

FRANK GREINER.

A Complicated Correction.

Editor American Machinist:

At page 1131, in my article "Steel Changing Shape in Hardening," by dropping the word "and" in the eighth line, which should read "*and* in which he states," and by changing the quotation marks after the word theory in the seventh line from the bottom from a double quotation mark and a period to a single quotation mark and a dash, and by placing the double quotation mark after the word theory at the bottom, you make "Perseverance" say of "L. O. W." what I said of "Perseverance." This gives "Perseverance" the credit of all of my thunder and makes "L. O. W." the scapegoat. W. H. CASTLE.

[If a fellow in the machine shop could so easily accomplish as much as a printer or an editor can do, he would revolutionize the trade.—Ed.]

A Chuck for Small Twist Drills.

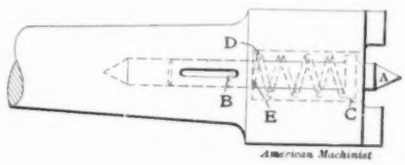
Editor American Machinist:

I had a small job on which there were about 250 small holes to be drilled. The lathe chucks we had on hand would not hold the drills, as they were too large. I found that one of the men had a Millers Falls hand drill. One end of the small spindle of this drill has the drill chuck, and the other has a small pinion secured to the spindle by a pin key. I drove the pin key out of the pinion, which allowed spindle and chuck to be removed; I clamped the spindle in a large lathe chuck, and with the small chuck on the outer end of the spindle could clamp any size drill. The work of changing did not take five minutes. TOOLROOM.

Center for Patternmakers' Lathe.

Editor American Machinist:

The sketch herewith shows a center for a wood lathe which I found convenient when turning split patterns. It is very annoying to find, after great care, that the



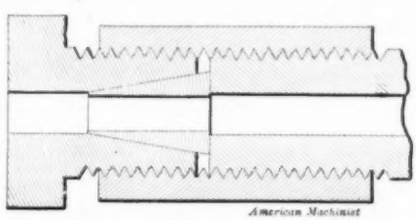
CENTER FOR WOOD LATHE.

center has shifted to one side and that one half of the pattern is thicker than the other, a branch pipe pattern, for example. *A* is a small center pin, *B* a cross pin in *A*, which moves in the slot and prevents *A* from falling out. *C* is a collar on *A* and *D* a light spring between *C* and *E*. In using this center it is not necessary to make a center hole in the wood—simply locate the center with a pencil and drop the center point *A* on it. *A* is not forced into the wood, but backs into the driver until the jaws engage in the wood. Both head and tail centers are made with spring points. PATTERNMAKER.

A Chuck or Guide for the Back End of the Hollow Spindle.

Editor American Machinist:

Any machinist who uses the hollow spindle lathe would appreciate a chuck on the back end of the spindle to hold the shaft or rod central. A couple of years ago I had occasion to splice a lathe spindle that had worn out in the back box. I



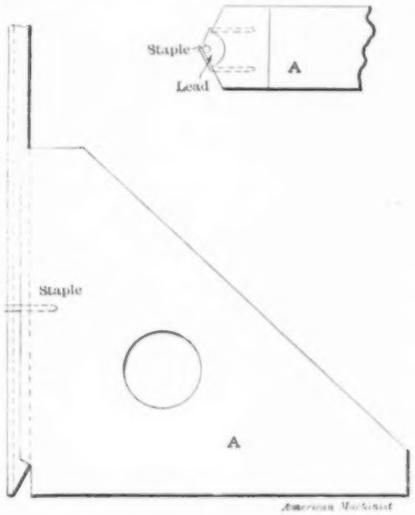
A CHUCK OR GUIDE FOR THE BACK END OF THE HOLLOW SPINDLE.

made the spindle longer than it was before and used a lock nut to take up the end motion. The threaded portion was about 1½ inches longer than needed for the lock nut. I made a chuck to use on that end that was quite satisfactory. I made a sleeve 3 or 4 inches long to screw on to the spindle, and into the sleeve I fitted a hollow set-screw with a taper hole. Then I made several sleeves tapered to fit the taper in the hollow set-screw, and with holes to fit the different rods or shafting we had occasion to work on in that lathe. Fastening the chuck on the work had no tendency to move it endways in the lathe. We also could fasten a piece in it to use as a stop or gage when it was desired to put the work just so far into the spindle. W. A. BRIGHT.

A Vertical Tracing Pencil.

Editor American Machinist:

Often when making a drawing or a pattern from a casting or pattern irregular in shape, or, in other words, not a flat surface so that the edges can be traced with a pencil or scratch point but curving upwards in parts, the tool as shown in the sketch has helped me and may help other readers of the AMERICAN MACHINIST. A triangular block of wood 1 inch thick, the right angle sides 4 inches long, has a pencil attached as shown. First plane the wood off one side of the pencil until the lead is exposed. The staple is driven tight enough to secure the pencil and as the



A VERTICAL TRACING PENCIL.

lead is worn the pencil can be slipped down. By placing work on a surface plate the edges can be traced by placing block *A* on the plate with the pencil against the edge of the work. This is part of my drawing kit. M. E. D.

Three Patternmakers and a Little Job.

Editor American Machinist:

A few days ago the boss gave three men three jobs all alike, or a job to each man. The job was to countersink twenty ¾-inch holes ⅝ inch deep in a cherry board, the face of which had a high finish. Said the boss, "I don't care if the holes are a little more or less than ⅝ inch deep, but I want a clean-cut hole, and do not disfigure the varnished face." The first man put a depth gage on his ⅜-inch bit; the bit was dull and the end of the gage was battered up, and the result was a ragged hole with the mark of the gage on the edge. The second bored a hole in a stick

and used this for a gage, but he did not look at the bit, with the same result as that of the first man—a ragged hole. These mechanics use their hands but not their heads.

The third man, an old fellow, who has been up against these little things before, took his 5/8-inch bit, examined it, saw it was dull, sharpened it up and started to bore without a gage, and when finished the holes were practically 5/8 inch deep, and a neat job was done. The other fellows could not understand how he got the holes the right depth without a gage, so they inquired from the old duffer (as they called him). "That's easy, boys. After the side cutting lips of the bit touch the wood I count the turns. Savy?"

Boys, keep your eye on the old "jours"; don't think you know it all.

A ROUNDER.

Grinding Expansion Taps.

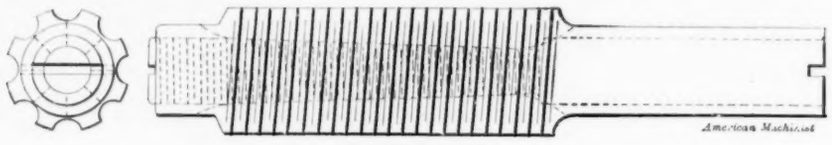
Editor American Machinist:

I have been interested in some of the descriptions of methods of grinding taps which have appeared in the columns of the AMERICAN MACHINIST, and hope that in relating my experience in the same line I may interest others. During the latter part of the late war, I had charge of the small toolroom in connection with a firm doing a large amount of government contract work on shells and projectiles. The first proposition that presented itself when I went there was to design a tap which would tap, in the cast-iron shells, a perfect fuse hole, or one so nearly perfect that the government inspector's O. K. stamp would go on the shells. This was, as some of the readers who have had similar experiences have probably found, rather hard to do.

To begin with, the only good lathe we had suitable for cutting taps would cut a drunken left-hand thread. By carefully going over the lathe, the trouble was found to be in a threaded collar on the lead screw which controlled the end bearing of the screw when cutting left-hand threads. The collar had not been faced true with the thread and, as the surface which the collar ran against was also out of true, the screw had an end movement of about .002 inch and formed a drunken thread. However, these defects were easily remedied, and when we put our standard thread gages (which were made in the navy yard at Washington) in the lathe and tested with an indicator, no error was apparent.

We found it would be a good plan to tap out the shells with a tap about .01 inch under size and use expansion taps for sizing and truing up the threads to gage. We then made two expansion taps like the sketch. First, they were bored out and a taper thread cut on the inside for the expanding plugs, and then they were roughed down all over to within 1-32 inch of size. We then annealed them and finished turning and cutting the thread, allowing .012 inch for grinding. The taps were hardened and found to be true within the limit allowed for grinding. A small 1/8 horse-power motor, with a wooden driving pulley 8 inches long, was attached to a shelf in the rear of the lathe and belted up to a grinding fixture held in the toolpost. The emery wheel was trued to the gage and the grinding finished to .001 inch of size. In truing the wheel a diamond was fastened to a convenient place on the carriage and the compound rest set to 30 degrees. By feeding in with the cross-feed one side of the wheel was trued; the compound rest was then reversed and the opposite side trued in the same manner. The edge of the wheel was trued to our gage. As the wheel was very hard, no trouble was experienced in keeping it true to grind the .001 inch. A Brown & Sharpe thread micrometer was used to test the taps and no error was found. After grinding the flutes of the taps, a shell was tapped, sawed in halves and tested with the plug and Prussian blue, the inspector's O. K. stamp going on all right.

Previous to making these two expansion taps a great deal of trouble was found in cleaning the tapped hole out thoroughly so as to enable the inspectors to try their gages quickly. This was overcome by making the taps with the hob form of teeth, so that in backing out all dirt was removed. These two taps were used day and night and finished sizing the fuse holes in nearly 6,000 shells. S. B. M.

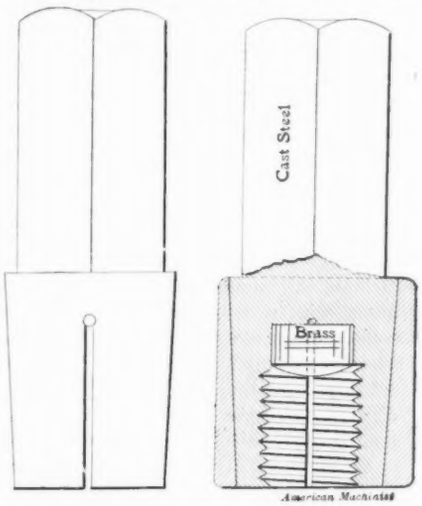


EXPANSION TAP.

A Releasing Stud Driver.

Editor American Machinist:

We all know how exasperating it is to have a stud come out when unscrewing a nut. We were not troubled in that way in the Pushfinger shop, for we had orders to "sock" them in tight, which we did, so that occasionally we twisted off the stud close up to the stud driver, and in getting out the broken end the thread of the driver would be ruined beyond repair. We tried all known kinds of drivers, and some that are not known, and I here present the sole survivor of our experiments as the very best. The body of the device has the end squared to fit a ratchet wrench. This squared end is then held in a four-jawed chuck while the other end is drilled and tapped and turned taper on the outside, about 3/4 inch per foot. The body also was slotted as per sketch, and the collar was bored a somewhat steeper taper, so that when it was forced home the slot in the body was closed at the point. The body had now to be retapped, and with a piece of brass pushed into the bottom the driver



A RELEASING DRIVER FOR SCREWING IN STUDS.

was ready for use. When a stud is twisted off we drive off the collar, the body opens and the stud end comes out easily.

ISAAC MORGAN.

Differential Indexing Applied.

Our readers will be interested to know that the means for accomplishing what is known as differential indexing, which was first introduced to our readers as the De Leeuw method,* has become a regular feature of the up-to-date universal milling machine, and we give three views of the gearing in place for such indexing on the latest type of Brown & Sharpe universal miller, the machine which we have previously referred to as being equipped with positive geared feed motion and other improvements.

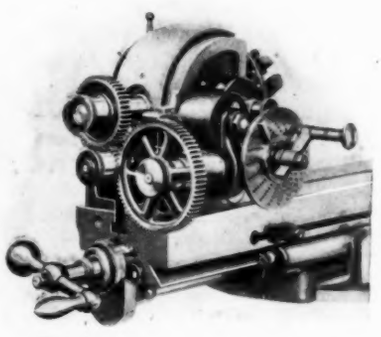


FIG. I. DIFFERENTIAL INDEXING.

The necessary arbor gears, etc., are now regularly furnished with all their universal machines, enabling anyone, by simply following the directions given in the table

*Concerning this method we have published articles at pages 58, 180, 298, 314, 334, 547, 601, 891, 979 and 997, Vol 24.

and by simple movements of the index-pin in the ordinary way, to correctly index any number whatever from 2 to 360, and in fact a large number of divisions beyond 360 may be obtained without extra gears or plates. The arbor, which extends through the spiral head spindle, is really simply a center for this spindle made longer so as to take the gear, as shown.

The principle of differential indexing has been sufficiently explained in the arti-

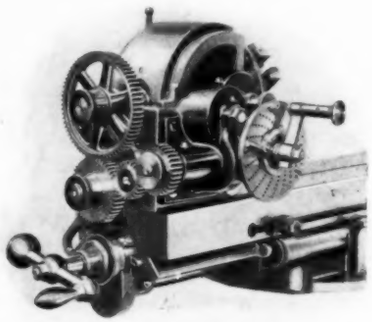


FIG. 2. DIFFERENTIAL INDEXING.

cles referred to and the method of applying it will be readily understood from the accompanying engravings. In the first of these the machine is geared to index 177 and the gear on the arbor has 48 teeth, the intermediate has 24 and the one on the spindle has 72 teeth, and for this the operator moves four holes in the 18 circle in the ordinary manner; a movement which without the gears would give a division of 180. The gears therefore move the index plate forward, *i. e.*, in the same direction as the index-pin to give the larger spacing.

In the second example we see the gears arranged with a second intermediate, so that the plate rotates in the opposite direction from that of the pin. These are to divide 169, and the gear on the arbor has

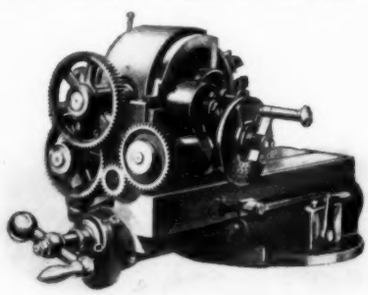


FIG. 3. DIFFERENTIAL INDEXING.

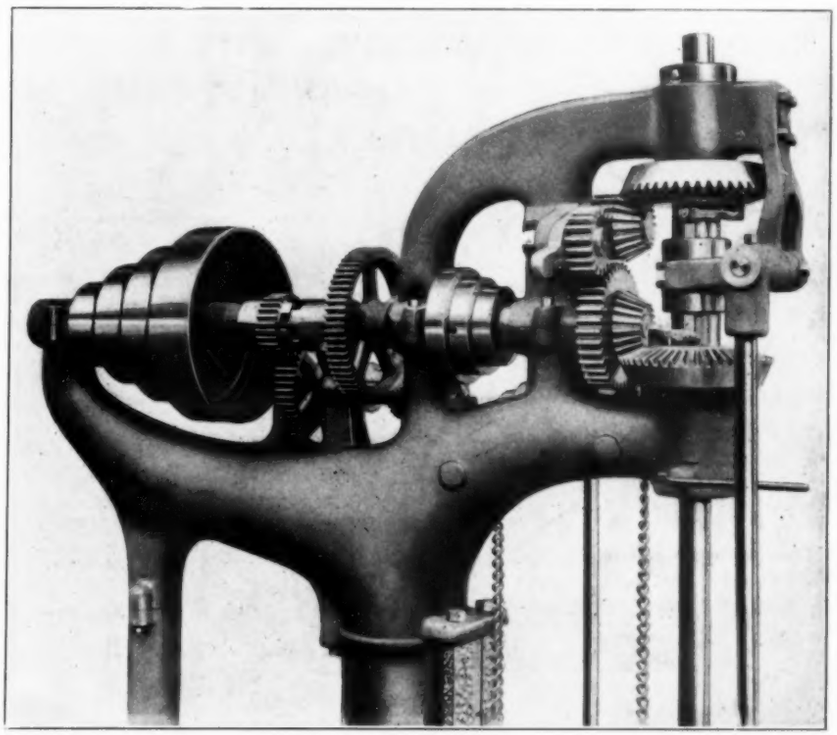
72 teeth, while that on the spindle has 32. For this division, 5 holes in the 20 circle are taken, which without the gears would give 160, and therefore the plate must move in a direction opposite to that of the pin enough to make the finer division.

In the third example we have compound gearing arranged to divide 319. In this gear 48 is on the worm, the compounding stud has gears 24 and 64 upon it, and the spindle gear is 72. For this division 4 holes are taken in the 29 circle, which without the gears would give divisions of 290. Therefore the gears must move the plate backwards, *i. e.*, in a direction opposite the movement of the index-pin to give the finer division. This distance is obviously $\frac{40}{290} - \frac{40}{319} = \frac{4}{319}$ of a turn.

The user need not, however, know how to compute the required turn of the plate nor the gears; he has only to put the gears and plates in place, as specified by a table accompanying the machine, move the index-pin as directed, and the spacing will be correct.

A Drill Press with Improved Tapping Arrangement.

At page 24, Vol. 24, we illustrated a drill press, fitted with a tapping device, built by the Cincinnati (Ohio) Machine Tool Company. The tapping mechanism has been improved recently in a number of ways. With the new arrangement the spindle, when backing, is driven at an increased speed; when work that does not require tapping is being handled in the machine the reversing gears may be quickly disengaged, thus they will be free from wear when not in use and will not consume power unnecessarily, and by simply moving a lever the spindle may be instantly stopped at any time without shifting the driving belt.



IMPROVED TAPPING ARRANGEMENT FOR DRILL PRESS.

The accompanying half-tone shows the upper part of the drill press and the tapping mechanism. The two bevel gears on the spindle are provided with friction clutches, opened by short arms which are swung outward by a key or feather carried in a sliding sleeve on the spindle. This sleeve is moved up and down by the vertical lever in front, and either gear is thus clutched to the spindle or released, as desired.

The spindle is driven ahead by the lower gear, this being driven by the small bevel on the horizontal driving shaft. Back of the small bevel gear is a spur gear, which drives, through the gearing shown above, the upper or reversing gear on the spindle. In tapping, when the desired depth is reached, the lever is thrown over, the lower gear released and the upper gear clutched to the spindle. The gears are so proportioned that the speed of the spindle when driven backward is twice as great as when it is driven ahead. Thus the tap is backed out very rapidly.

The intermediate gear is carried on an arm that may be swung up, by releasing a bolt, thus disconnecting the reversing gear when not needed for tapping. To stop the spindle, the operator has only to move the lever in front. This releases the friction in the driving gear and the spindle stops immediately. This is an important feature, for it enables the operator to quickly change drills, taps or chucks without having to shift the driving belt and wait for all the moving parts of the machine to come to rest.

The makers have made a number of tests with their 24-inch drill fitted with this tapping gear and find it will handle taps up to 2 inches in diameter, or 1½-inch pipe taps in cast iron.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *25,500 copies are printed. Total for 1902, so far, 668,000 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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The Office Building and the Hot Sidewalk.

The modern office building is as completely a product of engineering as is the locomotive. It is not, however, as entirely the product of one engineer. In the office building the architect and the mechanical engineer are assumed to collaborate. The collaboration we fear is sometimes a case of one riding over the other, and, as it is in the navy, it would seem that it is not the mechanical engineer who is on top. There is one circumstance which compels us to believe that the mechanical engineer is not accorded all his rights, or does not insist upon all his rights, in the design of the office building. This item of evidence is apt to be thrust upon the notice of whoever passes along the street contiguous to one of these buildings. The volumes of hot air poured out through some of the sidewalks constitute a nuisance, a destroyer of comfort, and a menace to health for which someone should be held responsible. We express no opinion except to say that it looks as if it was "on" the engineer. The one thing without which the building could not exist is the steam engine, with its boilers and their furnaces. The engineer has provision made for water supply, for coal supply, for air necessary for combustion, for conveying away the products of combustion, but adequate provision evidently is not made for the results of combustion, and he does not insist upon it. So far as he does not he is incompetent and should be held responsible for it. It is as much his duty to see that the hot air, if it must be got rid of, shall be so conveyed away as not to constitute an outrageous infringement upon the rights of the entire community, as it is to dispose of the smoke. If we are wrong and if it is the architect who is ultimately responsible, here is a beautiful place for him to assert his prerogative. If he is to have all the praise for what is so excellently done, he should shoulder also the thing which is to nobody's credit if it really belongs to him. The regulations of the building department of the city would seem to be in need of some improvement if they ignore this thing.

A New Phase of Machine Design.

A suggestion has come to us through the workings of our engraving department which it seems to us may have some importance in a much wider field. Much of the work of that department consists of the working up from plan and elevation of completely finished perspective drawings of machines which have not been built, and it has several times happened when these drawings were submitted to the designers of the machines that the perspective effect has brought out the defects of the lines and proportions of certain parts so clearly as to lead to important modifications of the design.

All experienced draftsmen understand the difficulty—we might, in fact, say impossibility—of judging from working drawings how many things will look in the finished machine. There is a certain class of pieces of which this is especially true, such pieces being those of which, in any one view, certain parts are shown edgewise while others are shown flatwise. The effect of the mass of such parts cannot be gathered by the eye from any one view of a working drawing, nor can the eye combine the effects of two views. The case is bad enough when the views are full size, but when they are drawn to a reduced scale the case becomes hopeless.

In some drawing offices in which attention is paid to the questions of outline and artistic proportions, large blackboards are provided on which a full-sized elevation of a new machine is drawn, in order to enable the designer to judge more correctly regarding these features. This plan overcomes the difficulty which is due to and inseparable from scale drawings, but it is nevertheless true that without the effect of perspective, correct judgment regarding the appearance of many parts cannot be formed.

The finished perspective drawing unquestionably comes nearer to supplying what is wanted than anything short of the finished machine, and it is a question if it would not be a paying investment for more draftsmen to learn the art of perspective. This art is usually looked upon as difficult, but it is no more so than many things which every competent draftsman must know. Of course finished results involve brush shading, and this, to the average man, is probably a more serious matter than perspective proper. From all points of view, too, the artistic sense plays an important part, and probably only those who possess that sense would be sufficiently successful at the work to make it worth while for them to take up the subject, though, for that matter, only those who possess it would be likely to undertake it at all.

Reading Drawings.

BY L. O. DANSE.

Not long ago I was in a drawing room—I don't say draughting room, because I am just a plain American, with a very big A—when in came a patternmaker who was evidently pretty mad, to judge from the way he went up to the head draftsman and said:

"Why don't you fellows finish your drawings before you send them into the shop?"

The drawing he had in his hand was a simple affair, in three views, arranged in the usual manner in third angle projection and showed the work perfectly, as was pointed out by the head draftsman.

The secret of the trouble lay in the peculiarities of the method of making drawings which long custom had fastened on the shop, and which had not been observed by the new draftsman who had made that particular drawing. One of

these peculiarities was the habit of projecting end views from the plan instead of from the front elevation. This puts the end view on its side as viewed from the bottom of the sheet, and necessitates viewing it from the right-hand end of the sheet to get it right side up. Probably this arrangement was originally adopted to insure leaving room for the title in the lower right-hand corner of the sheet.

Another peculiarity of their drawing-room methods is the excessive use of dotted lines in the attempt to make each view show everything. To one accustomed to ordinary methods this is quite confusing; but to those who have been for years reading drawings so made, the absence of the dotted lines makes the drawing seem a blank, and it is difficult for them to pass from one view to another to settle questions by the ordinary laws of projection.

One of the questions asked by the patternmaker illustrates this state of mind most beautifully: "Do you want round or square feet?" A glance at the drawing showed it to be a jig with four square feet flush with the corners. If the feet had been round they would have been shown with the base line of the jig above them, while, being square and flush, the base line filleted down into them. Had they not been flush, the question would have been permissible, as in that case the elevations would not have determined their shape, and it would have been necessary to dot them in on the plan.

In this part of the country it seems to be a general custom to make drawings full size, and much difficulty is experienced in keeping mechanics from going astray on small scale drawings, simply because of their lack of training in reading them. It would seem, to one who has not experienced this difficulty, that a properly dimensioned drawing is as easily read in one scale as another, but it is an absolute fact that the average man doesn't understand drawings unless they conform to the style to which he is accustomed.

Some years ago, while in charge of a railroad drawing room, I organized a shop class in drawing. Following out the results of my observations in the shop and drawing room, I decided that I must make a radical departure from the usual methods of teaching. The reason most people cannot draw is that they have not learned to see; so I started in to teach my class to see, and instead of letting them copy exercises during the class hour, I made them sit down while I went to the blackboard and analyzed the exercise, line by line and dot by dot, starting with the center line and building up the drawing, bringing out all the principles of elementary projection, back lining, shading, the construction of intersections and isometric projection. I interspersed my lectures with questions to the class, calculated to bring out the extent to which they had grasped the principles underlying the whole subject. At the close of my lecture I distributed hectograph copies of the exercise to the pupils, which were taken home and copied. Before beginning a lecture I examined the work of each pupil for the previous week, criticizing or commending as the case seemed to require, and calling the attention of the entire class to any errors common to several of the members and which seemed to indicate that some of my instructions had not been fully assimilated. At the end of twenty lessons those young men could not only make very fair drawings, but they were thoroughly grounded in the principles and could read any kind of a drawing with the utmost facility.

A sample of the questions I put to the class is: "Mr. Jones, I have just drawn one view of a nut, showing two faces. Is this a square or a hexagon nut?"

If Jones had been attentive, he could answer correctly at once, telling the difference between the projections of the two styles of nuts.

Again, I would ask: "Mr. Brown, I wish to show a rectangular raised panel here. Which lines should be made heavy to show that it is raised?" To which Brown would respond, "The right and lower."

Or, "Here is a nut in section. Mr. Smith, is this a right- or a left-hand thread?" And Smith would say, "It is a right-hand nut, because the threads are inclined the opposite way from a right-hand bolt."

I often wish that more of our mechanics had that kind of training in analyzing drawings and learning to see things—whether drawings or objects—in detail instead of in mass. I don't want them to wade through a dry course in descriptive geometry, but I do wish they all understood the application of the underlying principles of that science.

A Solder for Aluminum.

The following is from the specification of a United States patent recently issued to Joseph C. Webster, of Philadelphia:

I melt together, for heavy work, 5 parts of tin, 4 parts of lead, and then add to this 6 parts of melted aluminum. I then add 1 part of zinc, and after mixing the same thoroughly pour the composition into molds and allow the same to harden. For small or lighter work, I vary the proportions in the following manner: Six parts of tin, 5 parts of lead, 4 parts of aluminum, and 1 part of zinc.

The above compositions form an alloy which melts at a considerably lower temperature than the aluminum or parts to be soldered, and I find that no flux or scraping of the aluminum to remove the oxid is required and that the oxid that forms on the aluminum will not affect the joining of the metals or parts when the proper heat is obtained. It is understood, of course, that the last-named composition melts at a lower temperature and is preferable for light and delicate work.

In employing this solder it is understood that the usual brazing fire of gas and air for imparting a high heat is used and into which the aluminum or part to be soldered is placed, it being advisable to avoid having too much back heat from the bricks. The parts to be soldered are heated until the outer surfaces brighten or slightly soften. It is best to keep the solder near the flame, so that when a joint is heated sufficiently the solder is ready to melt and drop thereon in sufficient quantities to solder the same, after which a small paddle is used to smooth over the joint. It is of course understood that if the aluminum should get too hot, it should be allowed to cool for about one minute. When the joint is finished it should be allowed to cool slowly—that is to say, it should not be placed in water, for a quick cooling is apt to crack the soldered joints. I have found that after a joint is cooled and finished, it has the appearance of pure aluminum and will not oxidize or tarnish.

Peculiar Properties of an Alloy of Aluminum and Antimony.

The Aluminum World is responsible for the following: Aluminum and antimony both melt in the neighborhood of 630 degrees Cent. (= 1,165 degrees Fahr.), yet the alloy Al Sb, containing 18.87 per cent. of aluminum and 81.13 per cent. of antimony, melts only at 1,080 degrees Cent. (= 1,975 degrees Fahr.), which is a most marked exception to the general rule that alloys are more fusible than the least fusible metal they contain. Another general rule is that alloys have a smaller volume than their uncombined constituents, or, in other words, are heavier or denser than their theoretically calculated specific gravity. Edmond von Aubel has examined the alloy Al Sb in this respect, and finds that it is phenomenal in respect to its density as well as in its melting point. Its calculated specific gravity is 5.225, which is the density it would have if its ingredients alloyed with no contraction or expansion of volume. Its true specific gravity is 4.218, at 16 degrees Cent. This shows a large expansion of volume during alloying, and is thus a marked exception to the general rule that alloying is accompanied by contraction. To put the figures in another way, 7.07 cubic centimeters of aluminum alloying with 12.07 cubic centimeters of antimony, produce 23.71 cubic centimeters of alloy.

It is gratifying to know that, as stated in the *Tradesman*, "the cotton mills of Georgia, through the Georgia Industrial Association, have by common consent practically settled the child labor question in that State." The following are the principal and essential details of the settlement, the italics are ours:

1. That one week's work shall not exceed sixty-six hours.

2. That no child less than 12 years old

shall work at night in any cotton or woolen mill under any circumstances, and that no child less than 12 years old shall be allowed to work there at all; unless such child has a widowed mother, or physically disabled parents who are *dependent for support upon the labor of such child*, or unless such child can read and write, or unless such child attends school for four months of each calendar year; and provided, further, that no child under 10 years of age shall be permitted to work in any such mill or factory under any circumstances.

English Pipe Threads.

BY W. H. BOOTH.

It does not seem to be generally known that there is a standard for English pipe threads as for bolts, and that it was devised by the same man, Whitworth. The peculiarity of the system is that for all sizes of pipe from 1 inch upwards the number of threads per inch is the same, namely, eleven. All pipes from and including 1 inch have therefore nominally the same thread, and the difference of diameter measured at the top and bottom of the thread is, or should be, the same fraction, 0.1166 of an inch. This uniformity of thread is perhaps hardly necessary in the very large sizes, when the thickness of the pipes becomes greater than ¼ inch, but it is nevertheless universal and is sometimes a difficulty when putting together pipes of large diameter.

All pipe makers are supposed to adhere to the standard, but I regret to say some of them do not, while one maker I know is purposely wide of the standard—not merely inaccurate—the object being the somewhat mistaken one of preventing other makers' pipes being purchased to fit in. So far as my own practice is concerned, the result has been the other way, for I have always avoided pipes not to standard. The subjoined table gives the sizes of standard pipes on the threads. No matter what the thickness of the pipe may be its external diameter does not vary. All difference of thickness simply varies the internal diameter, so that an extra strong pipe has its internal diameter less than the nominal size.

The threaded part of a pipe is often very short, and it appears reasonable that it should be short when it is considered that the tightness of a screwed joint depends on the accurate contact of the threaded pipe and its socket. In the rapid manufacture of pipe great accuracy is not possible, and absolute contact is only obtained by the yielding of the surfaces which first come together. This allows the slacker places to come up tight. This would not be possible if the threaded part of the pipe was long, for so many early points of contact would occur that the ordinary screwing-up stress could not produce the necessary yield. There is one exception to the standard thread for pipes; I refer to artesian drive pipe. In these the ends of the pipes are reduced ⅛ inch before threading and the length threaded is long. The threaded portion also is parallel up to within a short distance of the end where it tapers rapidly off to the pipe body. The sockets are long and of thin steel, so that the outer diameter of the socket is but little above that of the pipe. When jointed up the pipes butt together at the middle of the socket, the pipe ends being faced to a joint surface. The socket at the same time screws home hard on the pipe at each end and conceals the thread entirely. Well casing will therefore stand heavy driving, owing to the butt joints, and they are always made in dead lengths, usually 10 feet, for the ready calculation necessary in artesian well work. They are screwed 12 threads to the inch, so as to weaken the pipe rather less than the ordinary 11 threads.

The Whitworth pipe thread is always known as the gas thread and is largely used in America for export goods, some American imported pipe work, valves, etc., having the English thread; but some of the American pump makers do not appear to know of the difference and send blank flanges screwed 8 threads per inch. My own personal observation of this coarser thread and the Whitworth leads me to think that the finer Whitworth thread makes the better steam joint in such cases as wrought-iron steam pipe with screwed-on flanges, which, I have observed, are more liable to leak when made with the coarser thread.

In my table I have given merely the ordinary sizes of pipe usually employed, but pipes are made to each ⅛ inch up to 3 inches diameter and then each ¼ inch

TABLE OF ENGLISH PIPE SIZES.

Nom. Size	External Diam. of Pipe Thread.	Diam. at bottom of Thread.
⅛	.382	.336
¼	.518	.451
½	.826	.734
¾	1.04	.949
1	1.309	1.192
1¼	1.65	1.533
1½	1.882	1.765
1¾	2.16	2.042
2	2.347	2.23
2½	3.000	2.882
3	3.485	3.368
4	4.340	4.223

beyond; but one rarely uses even the 1¾-inch size, though the 2-inch pipe is nearly double the area of the next usual size of 1½ inches, and similarly 3½-inch pipes are unusual, though a useful intermediate between 3 and 4 inch. In artesian work the usual sizes are 3, 4, 5, 6, 7¼, 8½, 10, 11½, 13, 14½, 16, 18 and 20 inches, these being the sizes which will conveniently pass one inside the other with the smallest convenient clearances at the arming shoe and socket. Some engineers use the flush jointed well casing, but the half joint is not suitable for heavy driving. It is difficult to get a butt on both the inside and outside joint and the stress of the blow comes wholly on the joint which butts, and this is battered and the threads are damaged before the other joint begins to take its share. Flush-jointed pipe may do for the rising main of a pump, but no artesian engineer can rely on it as he can on the usual drive pipe, though it has an entirely smooth exterior, and even the thin sockets of drive pipe offer considerable obstruction to driving and withdrawal, especially in clays, which close in upon a pipe.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(12) J. E. P. writes: I have some hardened bushings to make of several sizes from 1 inch and under and of a length about equal to the diameter. Can the holes in these bushings be lapped out parallel with a cast-iron lap and flour of emery, or must they be ground with a wheel to get the desired accuracy, or to get them accurate within 0.0001 inch? We have no facilities for internal grinding. I supposed the job could be done by lapping, but a friend tells me it could not. A.—The job can be done by lapping, but it will be slower than by grinding. The fact is that where work is of a grade requiring to be finished by lapping grinding is only what may be called a process of roughing out in preparation for the lapping, the latter being capable of much the more accurate and fine results.

A somewhat unusual incident recently put one of the ferryboats of New York out of service for several days. In overhauling and readjusting a pump that had been giving trouble, a fireman put his hand and arm above the elbow into a hole in the side of the cylinder or valve chest, accomplishing what was required but after that he was unable to get his arm out. The stoppage of the veins in the upper arm caused a rapid swelling and intense pain, so that anesthetics were administered, and the man was only released after cutting out a piece of the casting. Machinists worked on the job five or six hours with drills, saws and wedges. Then the boat had to wait until the casting could be replaced.

Will our friend in Toledo, Ohio, who signs himself "A. H.," kindly send full name to this office?

The Census Office gives out statistics of the locomotive manufactories of the United States for the year 1900. There were 28 locomotive works with a valuation of $40,813,793, which includes the land, buildings, machinery, tools and live capital, with no information as to the

capital stock of the various concerns. The value of the products for the year was $35,209,048. The wages for the year amounted to $10,899,614, incidental and miscellaneous expenses $1,369,341 and materials $20,174,395, this including freight and fuel.

Personal.

Frank H. Cathcart, recently with Dienelt & Eisenhardt, Philadelphia, has become works manager for the C. W. Hunt Company, West New Brighton, S. I.

E. E. Winship, for many years with the Warner & Swasey Company, of Cleveland, has severed his connection with that concern to become superintendent of the shops of the Beebe Indelible Check Protector Company at Minneapolis, Minn.

Commercial Review.

NEW YORK, September 2.

The volume of trade in the machinery market for August was more satisfactory than anticipated. At the beginning of the month the general opinion was that business would be dull, in consequence of the absence from the city of many on their vacations. While this was undoubtedly true, nevertheless orders came in with surprising regularity. They were mostly small ones, but they came with such frequency, as to form a large and remunerative total. In other words, it was the kind of business which demonstrated a healthy undertone to trade. Inquiries were numerous also, and the universal impression was that they indicated that a good fall business could be counted upon for a certainty. All apprehension regarding the recent advances in prices of machine tools seems to have disappeared, for which recent developments are responsible.

Reports have been published of a machine tool merger with a capitalization of from $40,000,000 to $50,000,000. No one in the trade, when questioned regarding the matter, knew anything about it. The consensus of opinion was that the combination was not even probable. The capitalization was looked upon as altogether out of proportion, especially when it is remembered that the Niles-Bement-Pond Company, the largeest concern in the machine tool business, is only capitalized at $8,000,000. An officer of this company is authority for the statement that it has not been approached in the matter, and he also said that he regarded it as visionary.

The application of the gas engine to various classes of pumping service is by no means new at the present time, but its use in connection with a natural gas constant pressure supply system is of much more recent occurrence. A new installation of this character is in progress at the works of the Logan Natural Gas Company of Lancaster, Ohio. This company furnishes the city of Lancaster with its entire gas supply for heating and lighting purposes, and the new installation will be utilized for supplying the entire distributing system with natural gas under constant pressure obtained directly from the company's wells.

The equipment consists of a 650 horsepower Westinghouse three-cylinder vertical gas engine which will be belted to a 14x36-inch duplex heavy pattern gas compressor. The engine is of the standard Westinghouse enclosed crank case type, and is provided with poppet inlet and exhaust valve, long trunk pistons and electric ignition apparatus.

The Pittsburgh Valve & Fittings Company is building new works at Barberton, Ohio, and has placed a contract with the Westinghouse Electric & Manufacturing Company for the electrical equipment, which includes generators, motors and switchboards.

The Jessop Steel Company, of England, is building a large steel plant at Washington, Pa., in which electrical power distribution will be employed. The company has recently purchased a considerable amount of direct-current apparatus from the Westinghouse Electric & Manufacturing Company.

A new line of taps is being placed on the market by the Superior Tap Company. The company was organized in Springfield, Vt., early in the present year with W. F. Cobb, president; W. W. Slack, treasurer, and F. H. Tandy, superintendent. They are devoting their attention exclusively to taps, and are employing their own improved methods for thread cutting, which insures a smooth and accurate thread. A circular has just been issued by them showing the styles they are now ready to furnish.

The contract for the new factory of the H. H. Franklin Manufacturing Company, of Syracuse, N. Y., has been let to James E. Leamy & Co., of Syracuse, to be completed by December 10, 1902. The main building is 110x52 feet and five stories high, and will be of slow-burning brick and timber construction.

Thos. Potter, Sons & Co., of Philadelphia, manufacturers of oil-cloth and linoleum, have adopted electric power distribution for the operation of their oil-cloth and linoleum printing machines, the blowers used for drying oil-cloth, elevators, and other general work throughout their plant. They have recently purchased from the Westinghouse Electric & Manufacturing Company six induction motors, which will be added to their present equipment of one 160-kilowatt and one 120-kilowatt two-phase 220-volt alternators, and fifteen or twenty induction motors.

The Vilter Manufacturing Company, builders of refrigerating machinery, Corliss steam engines, brewers' and bottlers' machinery, Milwaukee, Wis., have recently closed the following contracts: Ruston Ice & Fuel Company, Ruston, La., two 15-ton refrigerating machines; Monticello Ice Company, Monticello, Ark., one 15-ton refrigerating machine; Chartiers Valley Brewing Company, Carnegie, Pa., one 16-ton ice tank; G. Wildermuth Brewing Company, Pomeroy, Ohio, one 35-ton refrigerating and ice plant; Keokuk Poultry Company, Keokuk, Iowa, one 25-ton refrigerating machine; Monongahela Brewing Company, Clairton, Pa., one 75-ton refrigerating machine with 25-ton ice plant; Monessen Brewing Company, Monessen, Pa., one 50-ton refrigerating machine with 15-ton ice plant; Butler Brewing Company, Butler, Pa., one 75-ton refrigerating machine with 25-ton ice plant; French Market Ice Manufacturing Company, New Orleans, La., one 80-gross ton ice-making plant; City of Pittsburgh, for City Farm at Marshalsea, Pa., one 12½-ton refrigerating machine; Henry Rahr's Sons Company, Green Bay, Wis., one 25-ton refrigerating machine; I. N. Hagan, Uniontown, Pa., one 2-ton ice-making plant; Petoskey Brewing Company, Petoskey, Mich., two orders for brine piping; Midland Rice Milling Company, Midland, Tex., 17x42 Corliss engine; Adler & Oberndorf, Chicago Ill., 16x36 Corliss engine; Estate of Anson Eldred, Milwaukee, Wis., 16x30 Corliss engine; T. J. Gardner, Las Animas, Colo., 10x15x30 tandem compound Corliss engine; Menasha Paper Company, Menasha, Wis., 16x36 Corliss engine; Menasha Paper Company, for Ladysmith, Wis., 20x42 Corliss engine; Saginaw Valley Traction Company, Saginaw, Mich., 32x60 Corliss engine; Wm. Hellman & Co., Milwaukee, Wis., 8x24 Corliss engine.

W. R. Patzer has opened a branch office at Moscow, and is prepared to represent manufacturers of all kinds in the iron and steel industry, with which he has been connected seventeen years.

Merritt & Co., of Philadelphia, manufacturers of metal lockers, have obtained a large order for lockers from the New York *Press*.

E. F. Du Brul, of Cincinnati, Ohio, has accepted the appointment of Commissioner of the National Metal Trades Association. He will retire from active connection with the Miller, Du Brul & Peters Manufacturing Company, of Cincinnati, but will remain as director and vice-president of the company.

Announcement is made of the incorporation of the Chinese-American Commercial Company, and its incorporators are Henry F. Allen, agent of the Atlas Assurance Company, director of the Union Trust Company, Nevada Bank and San Francisco Savings Union; P. E. Bowles, president of the First National Bank of Oakland; Henry F. Fortmann, president of the Alaska Packers' Association and director of the California Safe Deposit and Trust Company; Rudolph Spreckels, director of the First National Bank of San Francisco and of the San Francisco Gas Company; Francis Cutting, vice-president of the California Fruit Canners' Association and president of the Cutting Fruit

Packing Company; W. H. Chickering, director of the American and Trust Company; George T. Hawley, treasurer of the Hawley Bros. Hardware Company; G. D. Greenwood, a well-known capitalist, and Ho Yow, Imperial Chinese Consul-General in San Francisco. The capital stock of the company has been fixed at $1,000,000 gold, of which $135,000 has been subscribed, each of the nine incorporators subscribing for $15,000 of the stock. The company will try to establish closer trade relations between this country and the Orient. Consul-General Ho Yow will temporarily resign from the Chinese Consular service for the purpose of managing the affairs of the company. He will go to China and remain there for the present, with a view of doing everything possible to secure and foster the introduction of American goods throughout the Empire. The company will be alive to all contracts which may be let in China for railroads, shipbuilding, mining, water works, telephone systems and the like. The market will be opened and developed likewise for machinery, lumber and implements of all kinds. The principal offices of the company in the United States will be in San Francisco, Chicago and New York.

An idea of the notable progress made in the iron and steel industry in the United States is furnished by recent figures promulgated by the Treasury Bureau of Statistics. In 1890 the wages and salaries paid amounted to $95,736,192, and in 1900 they amounted to $134,739,004. In 1892 the value of iron and steel manufactures aggregated $478,687,519, and in 1900 they amounted to $835,750,084.

In a communication to the government, bearing date August 1, Frank H. Mason, Consul-General at Berlin, writes as follows: "What is called in headlines by the German press, 'The Catastrophe in the Schuckert Electrical Company' has during the past week recalled public attention sharply to the conditions under which some of the great electrical corporations of Germany were promoted, and the embarrassments which some of the methods employed have more or less inevitably entailed. The event alluded to was a meeting on the 26th instant of the stockholders of the Schuckert Electrical Company at Nuremberg, at which the managers announced that, through depreciation of plant and material, insolvent accounts, and necessary appropriations for a reserve fund to meet further depreciations, the company had suffered losses aggregating 15,500,000 marks, or something more than $3,500,000. As the Schuckert Company is one of the foremost corporations of its class in Europe, with an up-to-date plant and all the accompaniments of a large business, some surprise has been expressed that its affairs should make such a bad showing for its shareholders. The explanation leads back to the fact, now well known here, that the sudden rise of some of the German electrical companies into corporations of vast resources and activities was, in some cases at least, the result of skillful and artificial creation of markets for products, rather than the supply of an actual and legitimate demand. Concisely stated, some of these companies bought their orders for electrical installations and materials by financial operations that left them shareholders in many enterprises which have since proven less promptly lucrative than had been hoped, and have thus drawn more or less heavily upon the capital of the parent companies."

A. R. Shepard, of Chicago, Ill., has been appointed secretary and treasurer of the Edmonds-Metzel Manufacturing Company of that city. The company, which manufactures hardware and electrical specialties, is having extensions made to its plant, which, when completed, will necessitate an increase in its working force of from four to five hundred men.

CHICAGO MACHINERY MARKET.

August is going out with a much livelier trade in machine tools than that with which it came in. There has been some summer depression in the volume. It was quite noticeable with a few sellers of machine tools, though almost undetected by others. But during the past two or three weeks there has been an abundant buying of shop equipment. It is one of the noticeable qualities of this trade that it comes chiefly from large concerns—that is, the part of the business that counts up on the ledger has its origin among that class of business. The Deering Harvester Company has bought a complete equipment for the machine shop to be operated in connection with its new rolling mill at South Chicago, splitting up the business among various sellers. The Nordberg Machinery Company, of Milwaukee, has been another large purchaser of tools, and Pawling & Harnischfeger and the Allis-Chalmers Company, of the same city, have likewise been good customers of the toolmakers. The Clergue Company at Sault Ste. Marie is a steady buyer, its representative usually coming to Chicago when he wants anything in that line and picking it up from the stock here. The Western Electric Company has done some buying recently. The Automatic Electric Company, of Chicago, bought this month tools aggregating in value about $9,000, mostly small tools to be used in the manufacture of telephone apparatus.

The American Steel & Wire Company bought from McDowell, Stocker & Co. machine tools to the value of about $7,000 for various plants. The Goodman Manufacturing Company, Chicago, has just doubled its capacity, to that end buying a $15,000 lot of tools from the Marshall & Huschart Machinery Company. The latter company has also sold a large order to the Chicago, Milwaukee & St. Paul road, and August will be the best month in their history.

While the higher prices established some weeks ago have not been invariably maintained, some tools evidently having been in stock here before the new level took effect and the holders allowing the machines to get away on the old basis, yet instances of that kind have perhaps been the exception. From the standpoint of the purchaser there is no quibbling about prices ordinarily. The sale is usually negotiated with ease. And not only has business been good during the past month, but the coming month promises equally well. Quite a number of bids are out and some of them will in all probability be closed within a few days. Usually the buying is to equip additions to old plants, the process of expansion not having subsided.

The Chicago Machine Tool Company was recently incorporated and will engage in the manufacture of machine tools at 12 South Canal street, Chicago.

Quotations.

NEW YORK, Tuesday, September 2.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:	
No. 1 X	$23 50 @ $25 00
No. 2 X	22 75 @ 23 50
No. 2 plain	22 25 @ 22 50
Southern:	
No. 1 Foundry	22 00 @ 23 00
No. 2 Foundry	21 75 @ 22 50
No. 3 Foundry	21 25 @ 22 75
No. 4 Foundry	20 25 @ 21 25

Bar Iron—Base Sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base Sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel — Base sizes — From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11½ @ 11⅝c.; electrolytic and casting, 11¼ @ 11⅜c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 27½ @ 27⅝c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5½c.

Antimony—Cookson's, 10¼c.; Hallett's and U. S., 7¾ @ 8c.

Lard Oil—Prime City, 79 @ 82c., according to brand and quantity ranging from one barrel up to large lots.

New Catalogs.

W. J. Adam, Joliet, Ill. The "Adam" green bone cutters. 3½x6, pp. 32, paper.

The Knecht Bros. Co., Cincinnati, Ohio. Friction drill presses. Descriptive booklet.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 29. Multipolar motors.

Newall Engineering Co., Ltd., London, E. C., England. Limits and limit gages. 4½x7, pp. 15, paper.

Chas. Winn & Co., Birmingham, England. Screwing machines, fitters' tools and steam fittings. 8½x11, pp. 38, paper.

Wm. G. Le Count, South Norwalk, Conn. Price list of machinists' tools and metal top slitting saw. 3½x5, pp. 23, paper.

The Hart Manufacturing Company, Cleveland, Ohio. Duplex die stocks and thread-cutting tools. 5½x8½, pp. 39, paper.

The Mine & Smelter Supply Company, Denver, Colo., and 139 Liberty street, New York. The Durkee electric drill. 6x9, pp. 23, paper.

The Skinner Chuck Co., New Britain, Conn. Lathe, drill and planer chucks, with supplement of scroll chucks. 6x9, 54 pages, paper.

Iroquois Machine Company, 150 Nassau street, New York. Metal grinding machinery. 6x9¼, pp. 63, printed in two colors, illuminated cover.

American Emery Wheel Works, Providence, R. I. Emery and corundum wheels, grinding machinery, loose emery and corundum. 6x9¼, pp. 79, paper.

Port Huron Air Tool Company, Port Huron, Mich. Compressed air motors, pneumatic drills, hammers and riveters and motor hoists. 5½x8½, pp. 23, paper.

Montgomery & Co., 105 Fulton street, New York. Catalog No. 21. General catalog of machinists' tools, machinery and supplies. 4½x6, pp. 704, profusely illustrated, paper.

Hayden & Derby Manufacturing Company, 85-89 Liberty street, New York. "Metropolitan" injectors. 6x9, pp. 48, printed in two colors on coated paper, half-tone illustrations, pebbled cover.

Bignall & Keeler Manufacturing Company, Edwardsville, Ill. Pipe threading and cutting-off machinery. 6x9. Circulars, printed on coated paper, attractively illustrated, bound in book form, with illuminated paper cover.

The Fosdick Machine Tool Company, Cincinnati, Ohio. Radial drills and drilling machinery. 6x9, pp. 80, paper. Printed on coated paper, half-tone illustrations and handsome embossed cover, making a very attractive catalog.

The Garvin Machine Company, Spring and Varick streets, New York. Catalog No. 8—screw macines, monitor lathes, forming machines and double turret screw machines—6x9, pp. 27, paper. Catalog No. 3—vertical milling machines—6x9, pp. 23, paper.

American Air Compressor Works, 26 Cortlandt street, New York. A pamphlet, 6x9, pp. 13, printed in Danish, descriptive of the American air lift pumping system and a few types of the American air compressors and Governors. It also contains cut and description of the direct-acting air compressor manufactured by the Union Steam Pump Company.

New Corporations.

National Road Machinery Co.; incorporated in New Jersey; capital, $100,000. Incorporators: Cleaveland V. Childs, George T. Mills and H. N. Smith.

American Fork & Hoe Co.; capital, $4,000,000; object, manufacturing agricultural implements. Incorporators: George H. Kelly, George G. Whitcomb, Joseph G. Russell and Arthur B. Rust, all of East Orange, N. J.

American Machine & Ordnance Co., of New York, incorporated with capital of $10,000,000, has filed a certificate extending its charter to cover the construction and equipment of railroads, tunnels and other improvements.

Parkes Machine Co., New York; capital, $500,000. Directors: William N. Parkes, Brooklyn; Allan McColloch, R. L. McCook, Phoenix Ingraham and A. A. Gulick, New York city; J. T. Boothroyd, Newburg, and J. M. Ferry, Bayonne, N. J.

The U. Baird Machinery Company, Pittsburgh, has been incorporated under the laws of Pennsylvania, the style of the new company being Baird Machinery Company. The company is composed of C. A. Wolfe, H. A. Reed, W. B. Wolfe, O. P. Meckel and J. L. McCartney. As in the past, it will be the aim of the company to represent high-class manufacturers of machinery and supplies.

Manufacturers.

The Lorain Steel Company, Lorain, O., will erect two new furnaces.

Fire has destroyed the boiler-house of the United Oil Company, Florence, Colo.

The Born Steel Range Company, of Cleveland, O., is building a factory addition.

It is rumored that the Illinois Central Railroad will erect a car-wheel factory at Waterloo, Ia.

The Largey Lumber Company will establish a planing mill and sash and door factory in Missoula, Mont.

An iron foundry building, to cost some $15,000, and workshops, are being built at the Dominion arsenal, Quebec.

The A. Garrison Foundry Company, Pittsburgh, Pa., has been granted permission to erect a pattern shop to cost $25,000.

The American Steel Foundries Company will make additions to the Sharon, Pa., works, which were recently absorbed.

The directors of the New Britain (Conn.) Machine Company have under consideration the erection of a new factory building.

At the P. & F. Corbin plant, New Britain, Conn., a 30x60-foot engine-house is about to be built. Electricity will be generated.

The reverberatory building of the Butte (Mont.) Reduction Works, owned by Senator W. A. Clark, was destroyed by fire August 22.

The G. F. Warner Manufacturing Company, New Haven, Conn., iron founder, is making arrangements to erect an addition to its plant.

It is believed that J. J. Hill, the railroad magnate, who recently visited Great Falls, Mont., intends to erect a steel plant in that vicinity.

The Pennsylvania Railroad is to increase the capacity of its Juniata shops 50 per cent. and construct a frog and signal plant. Work has begun.

The Indianapolis Gas Company is erecting a 3,000,000-foot gas tank and other structures. The main building, for making water gas, is yet to be built.

Contracts have been let for a five-story, 24x90-foot addition to the paint factory of the A. B. Ansbacher Company, 2635 Dearborn street, Chicago, Ill.

The Russell & Erwin Manufacturing Company, hardware, New Britain, Conn., has been having plans prepared for the proposed new factory on Myrtle street.

J. H. McPike, who is now operating a corrugated paper factory in Alton, Ill., proposes to erect also a plant that will manufacture paper principally from straw.

A hosiery mill will be erected in Philadelphia for B. W. Fleisher and Morris Pfaelzer. Adjoining the mill building will be an engine and boiler house, 31.6x94 feet.

A new boiler-house will be built for the W. H. Davenport Arms Company, Norwich, Conn. In it will be installed a new 100 horse-power boiler in addition to the present one.

It is stated in Toledo, O., that the Pennsylvania Railroad Company has purchased the ore mines of the Republic Steel Company, and will hereafter make its own steel rails.

The Lincoln Stove & Range Company, which now has a factory in Toledo, O., is building at Fremont, O. The machine shop will be 40x70 feet, two stories; the foundry, 70x100 feet.

Marvin & Casler are building an addition to their factory in Canastota, N. Y., due to a recent order from a foreign country for 2,500 embossing machines and other large transactions.

The Heimbacher Forge & Rolling Mill Company, St. Louis, Mo., has bought the old Madison rolling mill plant, not far from that city, partially destroyed by fire, and is rebuilding it.

The Sterlingworth Railway Supply Company, of Easton, Pa., has purchased a tract at Eddystone, Pa., and will erect a structure, 380x300 feet. It will be fitted with appliances for heavy work.

John F. Stairs, of Halifax, president of the Nova Scotia Steel & Coal Company, is quoted as saying that the company will erect a new steel plant and will also develop the No. 3 slope at the Sidneys.

The Pittsburgh Tool Steel Wire Company, of Pittsburgh, Pa. (works, Monaca, Beaver County, Pa.), now has its plant in operation. The product consists of drill rods, needle wire and other high-grade steel wires.

Excavations are being made for a coffer dam, 350 feet long, 30 feet thick at the base and 70 feet high, on the site of the powerhouse for the big electric plant of the Union Electric Light & Power Company, St. Louis, Mo.

The contract has been let for the stone and sewer work for a new factory to be erected by the officials of the Stirling Company, manufacturer of water tube boilers, Barberton, O. There will be two buildings, 100x60 and 255x55 feet.

It is reported from Chicago that the Campbell Investment Company has about closed a deal for the location of a large steel manufacturing plant in the Calumet district. The steel company proposing to build it is a new enterprise, manufacturing castings.

Philadelphia news is to the effect that R. C. Clarkson, architect, is preparing revised plans for a factory building at Burlington, N. J., for the Thomas Devlin Manufacturing Company. Thos. Devlin & Co., Philadelphia, are manufacturers of founders' hardware.

Another plant at Elizabeth, N. J., has been absorbed by the new shipbuilding trust. It is what was known as the Elizabethport Brass Works. It will be enlarged and used as an adjunct of the Crescent shipyard to make the brass trimmings required there.

Plans have been drawn up by the Tennessee Coal, Iron & Railroad Company to make improvements about their Ensley, Ala., furnace plant, which will cost something like $250,000. The company will put in a hoisting plant with bins for the raw material.

The Lion Portland Cement Company has commenced the erection of buildings near Nazareth, Pa. A mill of 1,500 barrels capacity daily will be erected. Dr. A. S. Rabenold, Ex-Sheriff Frank H. Schweyer and Morris J. Stephens, all of Allentown, are interested.

The American Time Recorder Company, of Chicago, has written to Mayor Pfennig, of Kenosha, Wis., asking that the city of Kenosha offer the company a site for the erection of a factory. The company will engage in the manufacture of time-recording machines and will employ 300 men.

The Portland (Me.) Iron & Steel Company's plant at Ligonia, South Portland, has been partially burned. The burned mills were devoted to the manufacture of bar steel and railroad supplies. The machine shop and scrap shed, which were separate from the main mill, were saved.

The United States Cigar Company will, it is said, put up a plant for the manufacture

of cigar boxes in Ironton, O., provided it can get a donation of land sufficient for the purpose. Newark, O., is competing for the prize. The cigar box plant of A. L. Stefanski, of Ironton, is in the consolidation.

The Wisconsin Malleable Iron Company, of Milwaukee, is reported to have given an option on its plant to Eastern men who are trying to effect a combination of all the malleable iron foundries of the United States. It is rumored that the United States Steel Corporation is behind the projected merger.

The Knell Air Brake Manufacturing Company, Ltd., Battle Creek, Mich., organized about two months ago, has its new factory in operation for the manufacture of Knell air brakes, air compressors and air hoists. The company will make a specialty of building special machinery, gear cutting, tool making, etc.

C. H. Halcomb, of New York, formerly president and general manager of the Crucible Steel Company of America, was recently in Buffalo looking at a 60-acre tract of land belonging to the Stony Point Land Company, which it is believed he with others is thinking of procuring for a new crucible steel plant.

A company has been organized at Burlington, Wis., to be known as the Burlington Brass Works, with the following officers: President, G. C. Rusch; vice-president, O. O. Storie; secretary and treasurer, John P. Gill. They have purchased five acres of ground and will begin work at once on a foundry and machine shop.

The Mix & Riddell Hardware Manufacturing Company, a newly organized company at Stamford, Conn., is having the plans made for a four-story, 200x40-foot building to manufacture a general line of builders' hardware. The company is capitalized at $500,000. Mr. Mix, it is said, has manufactured locks for fifty years.

A company has about been organized at Cuyahoga Falls, O., with a capital of $300,000 for the purpose of erecting and operating a nut, bolt and rivet plant. The promoters are J. E. Bell, formerly general sales agent of the Youngstown Manufacturing Company, and Charles R. Roof, formerly general superintendent of that plant.

Machinery is being built in the General Electric Works at Lynn, Mass., for a train, soon to be tried in Illinois, estimated to make 90 to 100 miles an hour. The line is about 150 miles long. The third-rail system will be used. A train of three cars has been built for the first trials. It will be equipped with twelve motors of 120 horse-power each.

The Sweet Tire & Rubber Company is a new corporation which will erect a factory in Batavia, N. Y. The company is capitalized at the outset at $80,000. John M. Sweet, ex-superintendent; Frank Richardson, ex-president, and Ashton W. Caney, ex-salesman, of the Batavia Carriage Wheel Company; John H. Ward, of the Farmers' Bank, and Orator F. Woodbury, of Le Roy, are the directors.

It is reported at Louisville, Ky., that Charles D. Gates, president and general manager of the Turner, Day & Woolworth Handle Company, has returned from New York, where he conferred with capitalists who are promoting a $25,000,000 trust, to take in the axe manufactories, handle manufactories and grindstone factories in this country and Canada. We presume that the grindstone feature may be limited to the wooden framework for same.

The Pell City Manufacturing Company is building a $1,000,000 cotton mill at Pell City, Ala. It will be five stories in hight. The company will employ 800 hands, and will not allow any child under fourteen years of age to work in the mill. A free school will be maintained, and all children under fourteen years of age will be educated. A settlement of several hundred houses will be built, provided with bathrooms. In addition to this there will be a large plunge bath for the male employees. The new town will be lighted by electricity.

An order for building one of the Manhattan style of engines has been received by the Allis-Chalmers Company from the Southern Electric Light & Power Company, of Philadelphia. The machinery is to be delivered at the earliest possible date. The engine will be 12,000 horse-power. There is a story that the design was worked out by Edwin Reynolds one day in January, 1900, on a sleeping car when he had been called to New York to present to the Manhattan Company designs for the largest and most powerful engine ever built, and for which he had nothing definite in his mind or in sketch when he left home.

The Jeannesville (Pa.) Iron Works Company, manufacturer of steam pumps, etc., is about to erect a new plant at Hazleton. The plans provide for six buildings, the main structure, 106x538 feet, divided into machine shop, foundry and casting cleaning departments. The other buildings include a pattern shop, two stories, 50x74 feet; a three-story and basement pattern storage building, 50x202 feet; a boiler and engine house, 47x87 feet, and a three-story office building, 60x65 feet. The machinery will be electrically driven. The cranes will be of 5 to 20 tons. The main building will be heated by the blower system, the remaining buildings by direct steam. There will be three cupolas in the foundry.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Stamping Dies. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A second-hand Jones & Lamson lathe; fair condition. Address Box 152, Ansonia, Conn.

Book, "Dies and Diemaking," 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

Agencies for mechanical goods for mill trade on Pacific coast. Address "Mill Supplies," care AMERICAN MACHINIST.

F. L. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Wanted.—Some reliable manufacturer wanted to make and place on the market, on royalty, the "Ermo" pipe wrench as described in AMERICAN MACHINIST, on page 1237.

Purchaser for an established manufacturing business, including patterns and tools; it is suitable for any first-class machine shop. Address No. 20, care AMERICAN MACHINIST.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears, catalog of small tools free. R. M. Clough, Tolland, Ct.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

A Canadian firm with well-equipped machine shop for handling medium heavy machine work would like to enter into an agreement with some American machine firm to manufacture their goods for the Canadian market. Address Box 833, AMER. MACH.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R.; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman, quick tracer, wishes position as assistant. Box 841, AM. MACH.

Mechanical draftsman desires position; practical shop experience. Box 839, AM. M.

Experienced mechanical draftsman, technical graduate, wishes position. Box 836, A. M.

For help, write The New York Engineering Agency, 35 Warren st., N. Y. No charge to employer.

As first-class patternmaker, with foremanship in view; good references. K. G., care AMERICAN MACHINIST.

A patternmaker of 35 years' experience wants position as foreman. Address Box 827, AMERICAN MACHINIST.

Position by competent machine shop or toolroom foreman; A1 references. Box 835, AMERICAN MACHINIST.

Young man, 25, 3 years' experience in factory, costs and contracts, desires position of some sort. Box 830, AMER. MACHINIST.

Machinist foreman, up to date, 17 years' experience, 8 years in charge, desires position as general foreman. Audress Box 824, AMERICAN MACHINIST.

Young man, 28, with 12 years' experience on tools, brass, pattern work and fine machinery, wants position as foreman. "O. K.," care AMERICAN MACHINIST.

Foreman machinist, good handler of help, hustler, with extensive experience of labor-saving methods and systems, open for position. Box 837, AMERICAN MACHINIST.

Wanted—Position as superintendent of plant or foreman of machine shop, by man of extended experience; references on request. Address C. E. Tower, South Bend, Ind.

Situation wanted by a trustworthy, competent, energetic and reliable machine shop foreman, now employed, on small or medium class of work. Box 840, AMER. MACHINIST.

Wanted—Position as superintendent or foreman of iron foundry; practical and successful; accustomed to estimating, etc. Address "Iron Age," care AMERICAN MACHINIST.

Experienced machine designer, practical, thorough, original, 10 years on automatic machinery, graduate, wants position of responsibility in or out of drafting room. Box 817, AMERICAN MACHINIST.

Assistant superintendent or foreman; A1 designer of jigs, tools, fixtures; experienced in dynamos, motors, electric parts, valves, brass material; age 30. Address Box 825, AMERICAN MACHINIST.

Superintendent and designer, 36 years, original ideas and thoroughly familiar with shop practice, drawing-room and office work, wants position; gas or oil engines preferred. Box 815, AMERICAN MACHINIST.

Position as foreman, by thorough, practical mechanic, age 35; accustomed to injectors, general brass work and steam specialties, including tools, patterns and molding machines. Address Box 823, AM. MACH.

First-class draftsman and designer of automatic machinery, 6 years machinist and toolmaker, 5 years draftsman, now employed, wants to change; vicinity of New York or Boston preferred. Box 838, AMER. MACH.

First-class machinist with 6 years' experience at all-round work desires position with good firm, to travel and erect machinery; understands thoroughly the handling and erecting of heavy machinery; A1 references. Address "Erector," care AMER. MACHINIST.

Assistant foundry foreman desires position as foreman in a shop employing about 20 men, or assistant in a larger shop; thoroughly practical on machinery, valves, etc.; also a

thorough knowledge of molding machines; good recommendations. Address No. 77, care AMERICAN MACHINIST.

Superintendent and skilled designer of machine tools and jigs and successful organizer and manager of men, with technical education, shop and drawing-room experience, including positions of chief draftsman and superintendent, desires to make a change. Address G. K., care AMERICAN MACHINIST.

Civil engineer wants position on railroad construction, as resident engineer, or with locating party in the field in Cuba, Mexico, Porto Rico or Philippine Islands; knows Spanish thoroughly; competent to handle native labor; 6 years' experience in Spanish-American countries; highest reference. Address, stating salary, location, etc., P. O. Box 1742, New York City.

Help Wanted.

Wanted—First-class machine designer. Address, with reference, Box 812, AMER. MACH.

For positions, send stamp to The New York Engineering Agency, 35 Warren st., N. Y., for registration blank.

Wanted—First-class machinist; state age, experience and salary expected. Box 834, AMERICAN MACHINIST.

Mechanical and structural draftsmen; experienced technical graduates preferred. Box 71, Station B, Cleveland, Ohio.

Wanted—Draftsman, experienced on punching and shearing machinery. Apply, stating age, salary, Box 796, AMER. MACHINIST.

Wanted—First-class diemakers to work on dies for sheet metal goods; steady work; state wages required. Address Box 828, A. M.

Wanted—An experienced foreman for milling department on light work; reference required. The Blinkensderfer Mfg. Co., Stamford, Conn.

Wanted—Several A1 draftsmen; give experience, reference and salary expected. Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

A first-class M. E. as general superintendent of heavy machinery works, located near New York city; best reference required. Address W. W., care AMER. MACHINIST.

Wanted—Young man, about 30 years of age, practical mechanic with some ability as salesman, to travel as machine tool demonstrator. Box 822, AMERICAN MACHINIST.

Wanted—First-class mechanical draftsmen; cranes, steam shovels, etc. Reply, stating age, experience and salary required, to Bucyrus Company, South Milwaukee, Wisconsin.

Wanted—Foreman to take charge of tool and die room for sheet metal manufacturing concern; must be thoroughly experienced. Address, stating salary expected, Box 829, A. M.

Wanted—First-class machinists experienced on compressor or engine work; steady employment for good men. Chicago Pneumatic Tool Company, Franklin Air Compressor Works, Franklin, Pa.

Three draftsmen at once to work on Willans central valve engines; must be familiar with metric system. Apply, giving experience, references and salary, to Bradley Mfg. Co., Pittsburgh, Pa.

Wanted—A first-class draftsman and designer with experience on pumps and pumping machinery; state experience in detail, references and salary expected. Box 794, AMERICAN MACHINIST.

Wanted—Man to take charge of milling machine department of manufactory making special machines; best of wages to the right man and steady employment. Address Box 832, AMERICAN MACHINIST.

Estimator.—Wanted—A man capable of estimating weight and cost of machine work from drawings; one having knowledge of structural work preferred; give experience and salary expected. Address Box 799, A. M.

Wanted—Experienced mechanical draftsman, Vermont, for general machine shop; specialty, paper-making machinery and mill work; state age, education, experience, with whom, and salary required. Box 804, AM. M.

Wanted—A man thoroughly competent to harden tool steel die blocks from a few ounces to 200 lbs. in weight; must be thoroughly experienced and well recommended in every way. Apply to Box 826, AMER. MACHINIST.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—A wide-awake foreman for the hoisting engine business; only those who are thoroughly up to date and mechanics need apply; good opening for the right party; state age, salary desired and references. Address "Hoisting Engine," care AM. MACH.

Wanted—Bright, active young man as assistant superintendent for a large machine shop, to take charge of all tools; must be a hustler and familiar with modern practice as to cutting speeds, etc.; state salary and experience. Box 795, AMERICAN MACHINIST.

A progressive concern wants to engage a machine shop foreman who can handle 30 or 40 men, get best results and devise labor-saving appliances; one familiar with power-transmission machinery preferred; state age, experience and salary expected; location near Chicago. Box 819, AMERICAN MACHINIST.

Wanted—An all-around machinist to keep in repair the machinery of a manufacturing plant; must be able to make small tools, do ordinary pattern work, run lathe, planer and drill; a steady position for the right man; send references, stating how long employed and what wages received. Box 803, AM. M.

Wanted—A first-class draftsman and designer of experience, who has also had actual shop practice and is capable of acting as superintendent or assistant manager of a plant building automatic machinery and working about 85 men. Address, stating age, experience and salary wanted, to "N.," care AMERICAN MACHINIST.

Wanted—A chief engineer to take charge of power-house developing 1,200 H.-P.; complete acquaintance with electrical power transmission, as well as with hydraulic and pneumatic work, will be required; answer, stating previous experience and giving references, also state salary expected; none but competent men need apply. Address Box 831, AMERICAN MACHINIST.

Wanted—Instructor in mechanical engineering to teach; machine shop, mechanical drawing and either steam engineering laboratory, patternmaking or foundry practice; M. E. graduate preferred; good chance for advancement. Send qualifications and recommendations at once to Mechanical Engineering Department, Washington Agricultural College, Pullman, Wash.

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Arbor Press
Barnes Co., W. F. & John, Rockford, Ill.
Montgomery & Co., New York.

Balls, Steel
Federal Mfg. Co., Cleveland, O.

Ball Bearings
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Barrels, Steel
Cleveland Wire Spring Co., Cleveland, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring
Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Oilless
Arguto Oilless Bearing Co., Philadelphia, Pa.

Belt Dressing
Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Philadelphia, Pa.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

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Shultz Belting Co., St. Louis, Mo.

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Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Bending Tools, Hand
Estep & Dolan, Sandwich, Ill.

Blocks and Tackles
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American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

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Spaulding Print Paper Co., Boston, Mass.

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Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

Boiler Washer and Tester
Rue Mfg. Co., Philadelphia, Pa.

Books, Mechanical
Baird & Co., Henry Carey, Philadelphia, Pa.
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Henley & Co., N. W., New York.
Holmes, Chas. H., Cleveland, O.

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Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
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American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
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Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
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Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
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Bulldozers
Williams, White & Co., Moline, Ill.

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Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

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Miami Brass Works, Hamilton, O.

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Christensen Engineering Co., Milwaukee, Wis.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

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Christensen Engineering Co., Milwaukee, Wis.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Uniform Steel Co., Newark, N. J.

Castings, Iron
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
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Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain Conn.
Westcott Chuck Co., Oneida, N. Y.
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Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
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Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wheaton Mach. Co., Boston, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandergrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Seliers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machine
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Alexander Mfg. Co., J. G., Grand Rapids, Mich.
Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
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Bement, Miles & Co., New York.
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Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
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Drilling Machines, Turret
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Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
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Cincinnati Mach. Tool Co., Cin., O.
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Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dresser
Dickinson, Thos. L., New York.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, Ohio.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

File and Tool Holder
Bowers, Geo. W., Waltham, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. F., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, H. G., St. Louis, Mo.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Russell, R. M., Binghamton, N. Y.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Saw
Keystone Machine Tool Works, Philadelphia, Pa.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Russell, R. M., Binghamton, N. Y.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Montgomery & Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Olmsted, H. L., Hasbrouck Heights, N. J.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Handles, Machine Shop
Norwood Mach. & Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters
Maxwell Engineering Co., Rome, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.
Woodman Mfg. & Supply Co., R., Boston, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
French Mfg. Co., Kansas City, Kan.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathe Feed
National Mach. Tool Co., Cin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincin., O.
Tanite Co., Stroudsburg, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Gump & Co., A. W., Dayton, O.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Special Machinery Co., Bridgeport, Conn.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
McCrosky & Huber, Cincinnati, O.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Machine Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Stevens & Co., Milo B., Washington, D. C.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Conn.
Olmstead & Co., H. B., New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Marston & Co., J. M., Boston, Mass.
Prentiss Tool & Supply Co., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Keystone Machine Tool Works, Philadelphia, Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Williams, White & Co., Moline, Ill.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Walcott & Son., Geo. D., Jackson Mich.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincinnati, O.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Mixing Machines
Smith Fdry. Supply Co., J. D. Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Keystone Machine Tool Works. Philadelphia, Pa.
Marston & Co., J. M., Boston Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Pratt Institute, Brooklyn, N. Y.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Gump & Co., A. W., Dayton, O.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.
York Mchry. Co., S. M., Cleveland, O.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Manchester, N. H.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers, Vertical Die
Rochester Die Shaper Co., Rochester, N. Y.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.
Walcott & Son., Geo. D., Jackson Mich.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Hermann Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Hermann Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburgh, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Fulton Fdry. & Mach. Co., Brooklyn, N. Y.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
McCrosky & Huber, Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Trucks, Shop
Towsley Mfg. Co., J. T., Cin., O.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh Pa.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hopkinson Mach. Works, Springfield, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding, Electric
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Special Machinery Co., Bridgeport, Conn.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

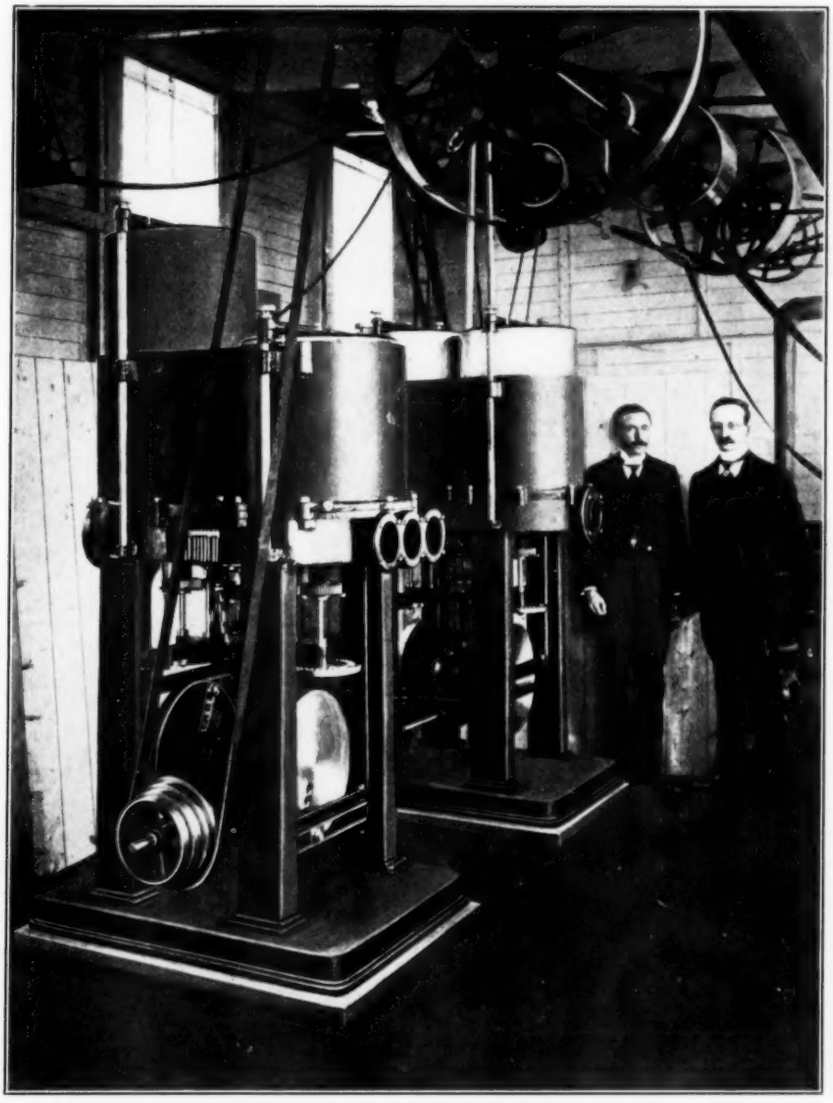
Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

The Respiration Calorimeter—A Curious and Interesting Example of Machine Construction.

Frederick Hart, of Poughkeepsie, N. Y., has recently built two machines which perform some very curious and interesting functions in a very interesting way, and we are glad to be able to present this full account of them, knowing that the machines will interest all who have much to do with machinery and who like to look over an admirable solution of a difficult problem in mechanics.



RESPIRATION CALORIMETERS IN THE SHOP OF THE DESIGNER AND BUILDER.

Most of those who keep in touch with the scientific work of the time know more or less of the experiments that have been carried on by Professor Atwater, of the Wesleyan University, Middletown, Conn., in determining the values of different foods. These experiments led finally to the development of an apparatus within which men were kept continuously for periods extending over several days, during which time the inhabitant of the chamber was kept under constant observation from the outside and was made comfortable. During the period of his confinement everything entering the chamber is measured or weighed, including air and heat. Also everything coming from the chamber is also measured or weighed, this including all gaseous, liquid and solid substances and heat as well. In this way a great deal of very precise and exact knowledge has been obtained regarding the relative values of foods, the effects of different occupations. In Europe this principle of experimentation has been applied to some of the smaller animals, and finally at the Pennsylvania State College an outfit was constructed for applying it to such animals as cows and horses, the results thus obtained being found useful in choosing the foods and in regulating the quantities supplied.

Food is burned in the body somewhat as coal is burned in a locomotive, and gives much the same final results, viz., heat and motion. A bushel of corn or a bale of hay if burned in a furnace gives off a certain definite amount of energy as heat. If we feed the corn or the hay to an animal, we supply the animal with just that total amount of energy. The aim of the experiments to be undertaken with the respiration-calorimeter is to find out what proportion of this energy can be utilized by the animal to produce meat or milk or work, and how much is simply used up in heating the surrounding air. A comparison of corn and hay, for example in this respect, will show which one contains the greater store of energy in available form. Similarly, a comparison may be made of the ability of different animals to utilize the energy of the same food, or of the influence of various external conditions, such as temperature, water supply, light, excitement, etc.

The comparisons are made much as we might make them with a locomotive. Knowing the energy contained in the coal, an analysis of the waste products, including the gases from the stack, and a determination of the heat given off, would furnish the elements necessary for the comparison. In the case of the animal, the visible excreta can be readily collected and analyzed by proper appliances. The flue gases are represented by the breath of the animal, the gases of which are carried out of the chamber in the current of air.

The maintenance of this current of air, the accurate measurement of its volume and the delivery at certain stated periods of a known proportion of it for analysis, the air to be handled in such a way as not to increase its temperature at all, nor to bring it in contact with lubricating oils or other substances which would cause it to absorb things that might vitiate the subsequent chemical analysis, was the problem presented to the builder of the machine. Besides, it was desirable that the volume of air per stroke of the machine should be capable of change and that the speed of the machine should also be variable to suit conditions; that the aliquot parts of the air delivered should be variable, *i. e.*, 0.01, 0.005 or 0.0025; the air must not be appreciably heated and the machine must run at times for as much as sixty days without a stop.

The first of these machines was built for the Pennsylvania State College, the two later ones for the German Agricultural Station at Bonn, and the Hungarian Agricultural Station at Budapest.

The half-tone engravings show the two machines built for shipment abroad as they appeared complete upon Mr. Hart's shop floor and also partially dismembered; one view showing the valve face on which the aliquoting valve rests and rotates, also the valve in place.

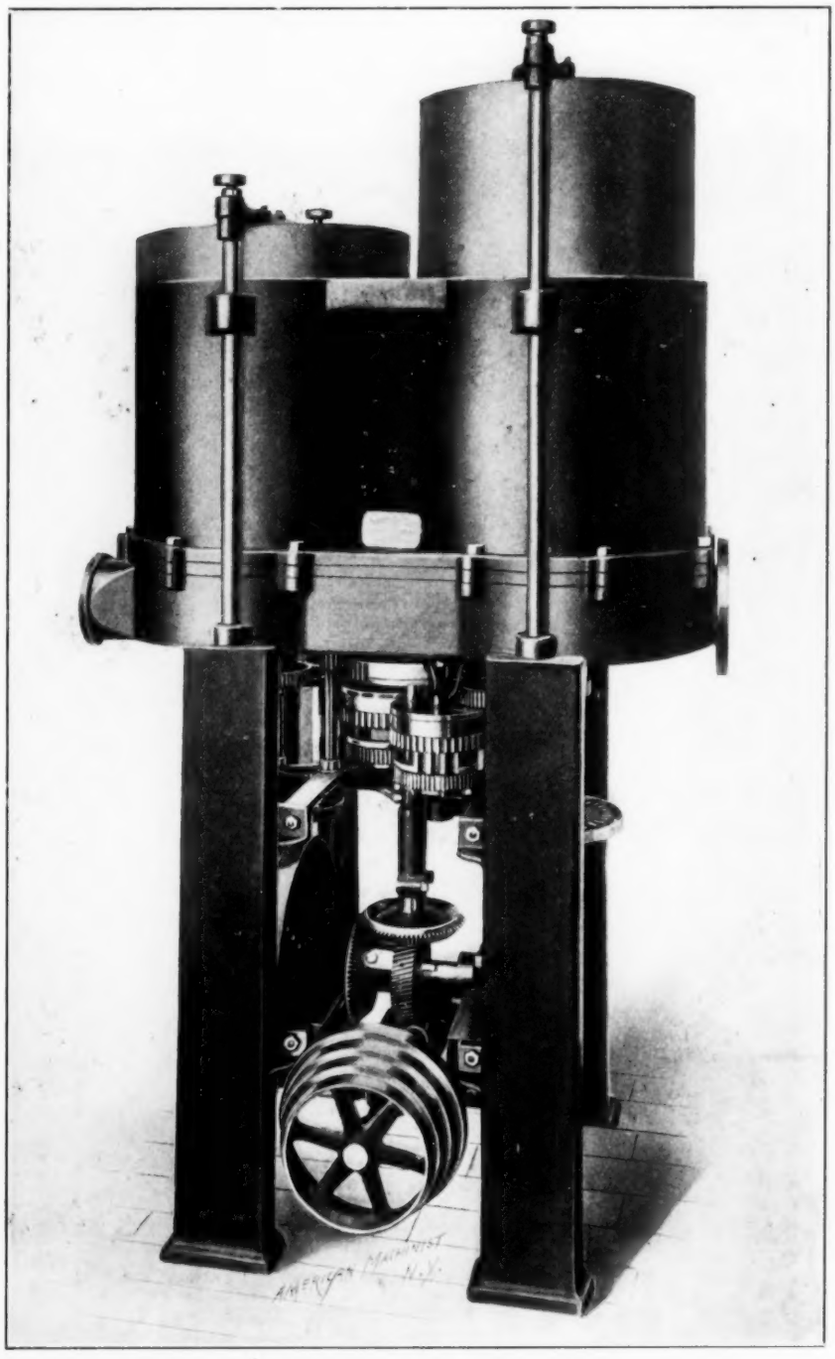
Of the drawings, Fig. 1 is an end elevation, Fig. 2 is a side view of the machine half in section, Fig. 3 is the aliquoting train of gears, Fig. 4 is the main valve train of gears, Fig. 9 is a sectional view of the valve gear, Figs. 5, 6 and 7 are sec-

tional plans of this valve gear at different points as indicated, Figs. 8 and 10 are plans of the valves and ports.

Motion is imparted to the machine by the cone pulley shown in Fig. 1 on the right of the machine. This cone is keyed to shaft 1 on which is a spiral gear that drives the crank shaft 2; this crank shaft has at each end a disk crank with a crank pin that can be shifted into different holes so as to give different lengths of stroke. On shaft 2 is a pair of miter gears for driving the vertical shaft 3; this shaft makes one turn in unison with shaft 2, and from this shaft is driven a train of gears which moves the main valve (marked *M V*), and the aliquoting valve (marked *A V*), Fig. 8. The main valve is driven through gear 1′ which by reference to Fig. 4 will be seen to have two groups of four teeth each at opposite sides of the gear. This gears into 2′ in such a way that for every rotation of the machine the gear 2′ makes two half-turns—that is, a half-turn at the instant that the crank is at the top and another when the crank is at the bottom of the stroke. On the other end of the shaft 4 (Fig. 2) on which pinion 2′ is fastened, is a two-toothed pinion 3′, which for every half-turn advances gear 4′ (Figs. 2, 5, 6 and 7) one tooth. Gear 4′ is fastened to the end of shaft 5 (Fig. 2) to the upper end of which is fastened a cross-bar or driver. The main valve has two pairs of lugs which fit down over the ends of the cross-bar in such a manner that this shaft is free to move vertically to a limited extent without in any way displacing the main valve. Wheel 4′ has just as many teeth as there are induction and eduction parts; the main valve (Fig. 8) has just half as many ports, so that as it is moving round on top of the valve seat it opens to the air receiver the induction ports marked *I P*, or the eduction ports marked *E P* alternately.

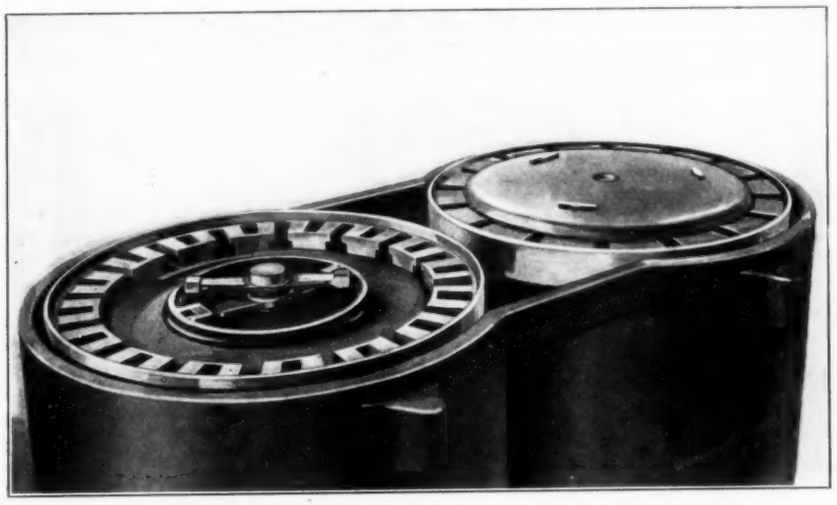
The aliquoting mechanism is driven from shaft 3 by the pinion 1*a* (see Figs. 9 and 3), which is also an intermittent gear like 1′, only in this case it has only four teeth and moves wheel 2*a* one-tenth of a turn for every rotation of the machine. Attached to the wheel 2*a* is wheel 3*a*, which has four teeth. This moves pinion 4*a* one-quarter of a turn for two consecutive turns of the machine, and then dwells for eight consecutive turns. Pinion 5*a* is attached to 4*a*, and for every one-quarter of a turn of 5*a* spur wheel 6*a* moves one-twentieth of a turn, so that wheel 6*a* moves one-twentieth for two consecutive turns of the machine and dwells for ninety-eight consecutive turns of the machine. Wheel 7*a* is fixed to 6*a* and is an intermittent gear having only four teeth which occupy just one-tenth of its pitch circumference, and, since 6*a* and 7*a* both move one-twentieth of a turn to one rotation of the machine, pinion 8*a* will move one-quarter of a turn; 9*a B* which is fixed to 8*a* will therefore make one-quarter of a turn for two consecutive rotations of the machine and dwell during ninety-eight rotations. Wheel 9*a B* gears into 10*a*, which is of the same pitch diameter, and is fastened to the end of the tubular shaft on which is mounted the aliquoting valve. 9*a B* is an intermittent gear and operates upon 10*a* during only half a turn; consequently 10*a* makes one-quarter of a turn for each of two consecutive rotations of the machine and dwells during 198 turns. The time occupied in making this movement, therefore, is only during one-quarter of the rotation, and the movement occurs during the up-stroke of the air receiver in conjunction with which this valve operates. Of course, the movements of the main valve are so timed that the induction ports are opened and the eduction ports closed during this up-stroke.

Referring to Figs. 8 and 10, it will be seen that the aliquoting valve *A V* has only one opening through it, but that its seat has four openings, two of which (marked *M O*) communicate with the same outlet pipe, which is termed the main outlet. The port marked *A P* 1 communicates with aliquoting port 1, and *A P* 2 communicates with aliquoting port 2 at the right of Fig. 8. If the aliquoting valve is positioned as shown in Fig. 8, and the gearing is in such a position as to move the valve, then the port in the ali-



SIDE VIEW OF RESPIRATION CALORIMETER.

quoting valve will travel from the port marked *M O* to the port marked *A P* 1, and it will commence to do this when the crank has traveled from the dead center one-eighth of a turn, or thereabouts, and stops before it has reached the other dead center by one-eighth, then the air receiver will make the down-stroke and discharge through *A P* 1. During its next ascent the valve will move another one-quarter



VALVE-FACE AND VALVES. RESPIRATION CALORIMETER.

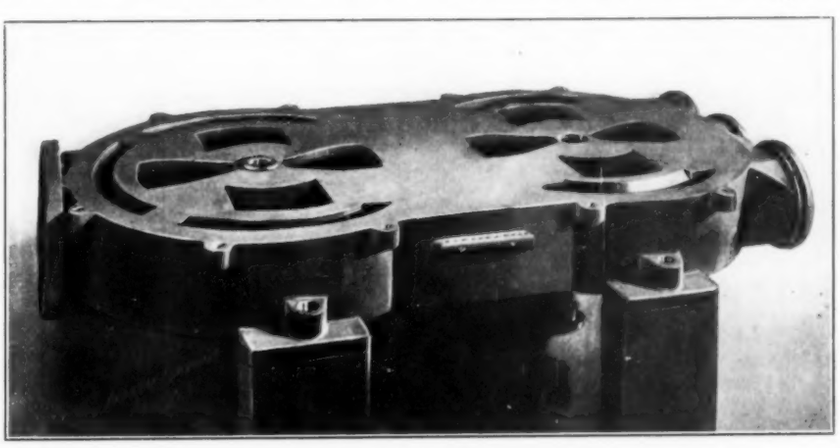
turn to the other main outlet (*M O*) and will remain there during 198 turns, when it will complete its rotation. The valves of the other air receiver can, of course, either work in unison with these valves or be made to move exactly in the middle of the dwell. By removing the keeper of gear 9 *a B* (Fig. 3) and substituting the other part of the gear, making it a continuous gear like 9 *a A*, the aliquoting valve will then make two consecutive movements and dwell ninety-eight, so taking 1 per cent., or the air of one stroke in one hundred. If on the gears attached to one air receiver all the teeth are removed from 9 *a B* and a continuous keeper substituted, making it like 9 *a C*, this will prevent the aliquoting valve from moving, and so prevent the aliquot charge from being taken from the air receiver, thus reducing the volume of the aliquot part to .0025.

The object of having two aliquoting ports is to give more time for making an analysis. The aliquoting ports 1 and 2 discharge into different analytic chambers, so that two operators can be working on the analysis at the same time. This, however, added quite a little to the difficulty of accomplishing what was desired.

The annular space in which the air receivers work up and down is filled with mercury, and one annular space communicates with the other by a large passageway at the bottom, and also at the top, so that as the receivers rise and fall alternately the level of the mercury does not change.

In altering the stroke of the machine, the nuts marked *X*, which are made of different lengths, are also changed, so that by removing the top nut which screws directly on the side bars and removing nut *X* from the yoke, replacing it by one which corresponds with the amount of reduction of the stroke of the machine, caused by changing the position of the crank-pin, and then coupling up again, the air receiver will work always at the bottom of the stroke—that is, the shortening of the stroke has been from the top end and not from the bottom end, so that the air receivers are emptied at every stroke no matter what the stroke may be. The passage of the air through the machine starts at the ports shown by the arrow at the left of Fig. 10, passing around the outside of the machine and up to either of the air receivers through the ports marked *I P* (designated by arrows in Fig. 10); thereupon, the air receiver descending, it goes out through the ports marked *E P* and into the space between the main valve and the aliquoting valve, then down through the main port, as indicated by the arrow, or down through one of the aliquoting ports and so out of the machine to either the main refrigerator or to the analytical chambers.

By sealing the air receivers with mercury the temperature of the air is not raised, as there is no friction, which there would have been in using a piston in a cylinder; neither were the chemical constituents changed, as they would have been with a piston on account of the oil necessary for lubrication. The measuring of the air was found to be exceedingly accurate, as at the highest speed of the machine the difference between the atmospheric pressure on the outside and the inside of the air receiver was so small as not to be discernable with the most delicate gage, and the machines ha ' been run continuously for considerably over a week.



PORT OPENINGS AT BASE OF CYLINDERS. RESPIRATION CALORIMETER.

Railroad Engineering Reminiscences.

The thirtieth anniversary of the New York Railroad Club could not have been more fittingly and happily celebrated than it actually was in listening to the half-century reminiscences of M. N. Forney, the veteran railroad engineering expert, inventor, editor and general writer. His address was of great length and was followed with the closest interest and unflogging attention throughout. The body of the address was an interesting sketch of the development of the American locomotive, which should only be reproduced in its entirety, and this our space will not permit. The isolated portions here given will be found well worth reading:

. . . . . .

Quite some years ago, while your speaker was editing a paper, we had an occasional visitor who when he had finished his interview with my assistant, would inquire of him whether "he ever lubricated the amenities of civilized life." It was intended to be a polite invitation to take a drink. Quite a regular attendant at these early meetings of the Railroad Club was a member in the supply business. He would usually remain in the lobby outside the meeting room, and with the door ajar

would catch the eyes of different members who were railroad men and crook his finger, which had the same meaning as the euphonious invitation of our visitor of former days. In this way many experiments in different kinds of lubrication were made outside of the Liberty Street rooms, besides those which were made within; in justice to the members, though, it should be said that they rarely lost their bearings!

. . . . . .

If we make a comparison of some of the meetings of those days with our recent ones, the contrast will be very great. It was hard then to maintain interest in the proceedings, although we sometimes worked ourselves up into a high temperature, but these early members who kept up their interest in the proceedings, and their allegiance to the Club and its objects, like Dickens' character, deserved a great deal of credit for being "jolly." Nevertheless, the proceedings of the Club, to a very great extent, served their purpose by exciting interest in subjects in which railroad companies and railroad officers were concerned.

The efficiency of discussion, of agitation, or disputation—talk, if you choose to call it that—is of very great importance in nearly all relations of life—the friction of minds against each other is like that of putting encrusted locomotive tubes into a rattler and revolving it; it knocks off the scale and corrosion and makes them

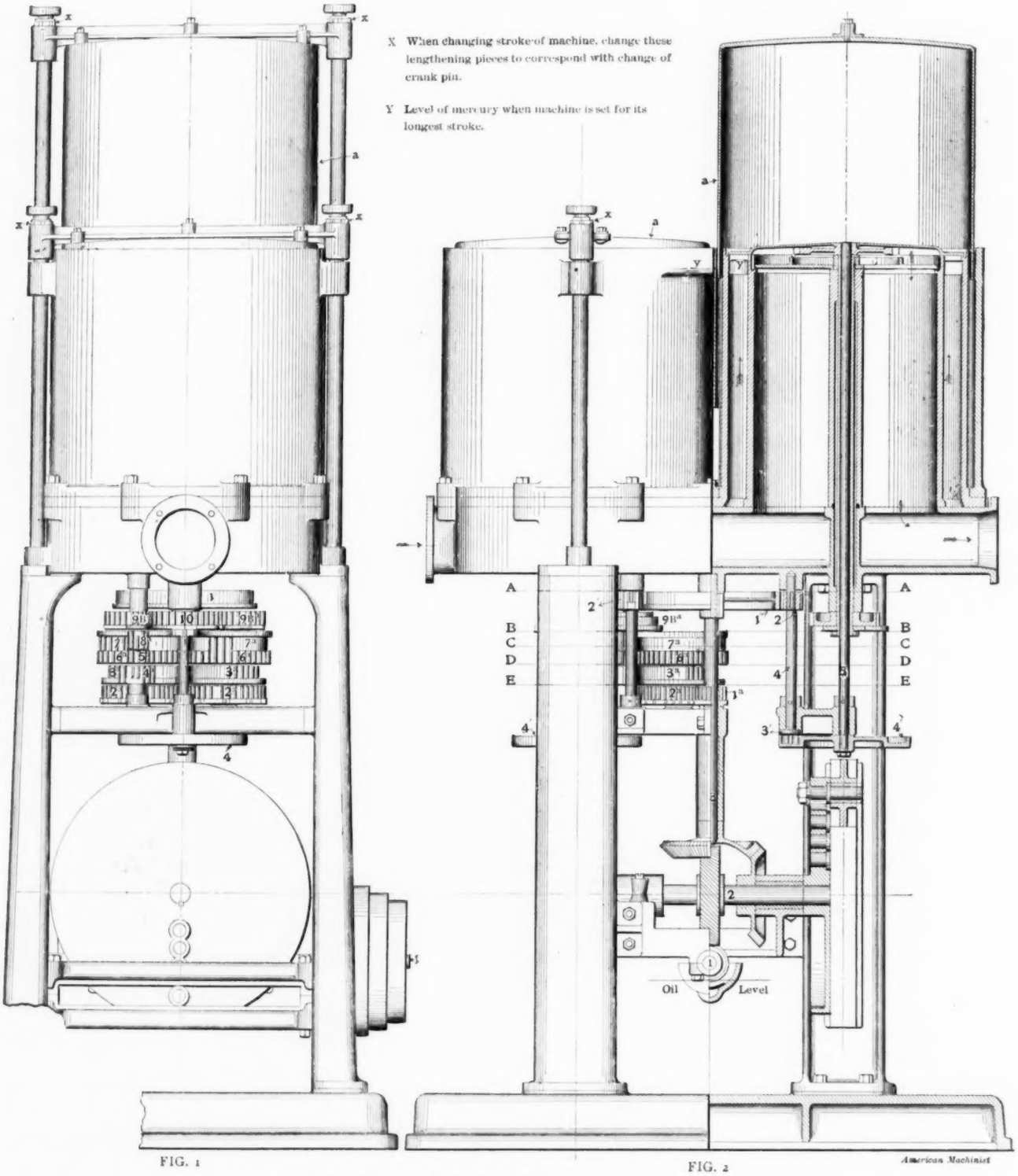

X When changing stroke of machine, change these lengthening pieces to correspond with change of crank pin.
Y Level of mercury when machine is set for its longest stroke.
Oil Level
A
B
C
D
E
American Machinist

FIG. 1 FIG. 2

REAR AND SIDE VIEWS OF RESPIRATION CALORIMETER.

clean and bright. Men's minds get encrusted with all kinds of delusions, mistakes, prejudices and fallacies. Put them into an assemblage like this, and let them come in contact with each other, and the mental excrescences will be knocked and worn off and you may finally be able to take them out of this intellectual rattler clean and bright and leave the incrustation behind. It has been said that every assembly—except a Quaker meeting—in its prime intent and use is a talking body. The word "parliament" is composed of the word "parley"—which means to speak with another—and a suffix. It has been said, too, that in most controversies there is some truth on both sides, and therefore the purpose of discussion is to bring out the truth on each side. Dr. Holmes said that not only are there two sides to all questions, but he thought most subjects are at least hexagonal.

. . . . . .

To make the biographical part as brief as possible, it may be said that, if the family Bible tells the truth, your speaker was born on the 28th of March, 1835, in Hanover, York County, Pennsylvania. His ancestors were of German origin and came to this country in 1721. An ancient document, which has survived to the present day, is a certificate, written by a burgomaster in Germany, which testifies to the good character of the original Forney who emigrated to this country in 1721 and who it was said therein was a tailor—but a reputable man—and worthy of confidence.

A little incident happened a few years ago which shows the influence of heredity. Your speaker then had rooms in a building within gunshot of this place, the first floor of which was occupied by a tailor shop. At one time while he was an occupant there, the tailors employed in the shop had a strike and put out pickets to prevent new men from going to work in their places. Of course the lodgers in the rooms, your speaker among the number, had occasion to go to and from their apartments several times a day. The pickets were Germans and must have been observant men, because on four different occasions they hailed your speaker and inquired, "*Sind Sie ein schneider?*" that is, "Are you a tailor?" So you see blood will tell after the expiration of more than 180 years.

When the age for going to work arrived, locomotives filled my imagination, as they have that of many another boy, and I had then somewhat the feeling of a youth who runs the elevator in the building which is now my home. He is ambitious and has been pestering me about getting into a machine shop as an apprentice or fireman. A few days ago he told me in confidence that he "had a high talent for machinery." Fifty years ago those were my sentiments; but alas, how one's estimate of oneself is changed by years and experience and rubbing up against the rough places of life. I want, however, to say, in behalf of our elevator boy, that if any of you want the services of a youth who thinks he "has a high talent for machinery," I know where there is such a one.

. . . . . .

During my employment on the Illinois Central Railroad their shops were located in Chicago near where the present passenger station now stands. To show how slight events sometimes lead to more important ones, it will be explained that my boarding place was then in Wabash avenue, near Washington street, a locality now covered with skyscrapers, and my daily walk was on Michigan avenue to and from the shops. The track of the Illinois Central road then extended on piling over the lake, and from the shops to the station, which was then about a mile farther north. There were at that time on the road some four-wheeled switching engines which weighed about 20 tons, and had four-wheeled tenders. These engines would pull as heavy a train as the heavier eight-

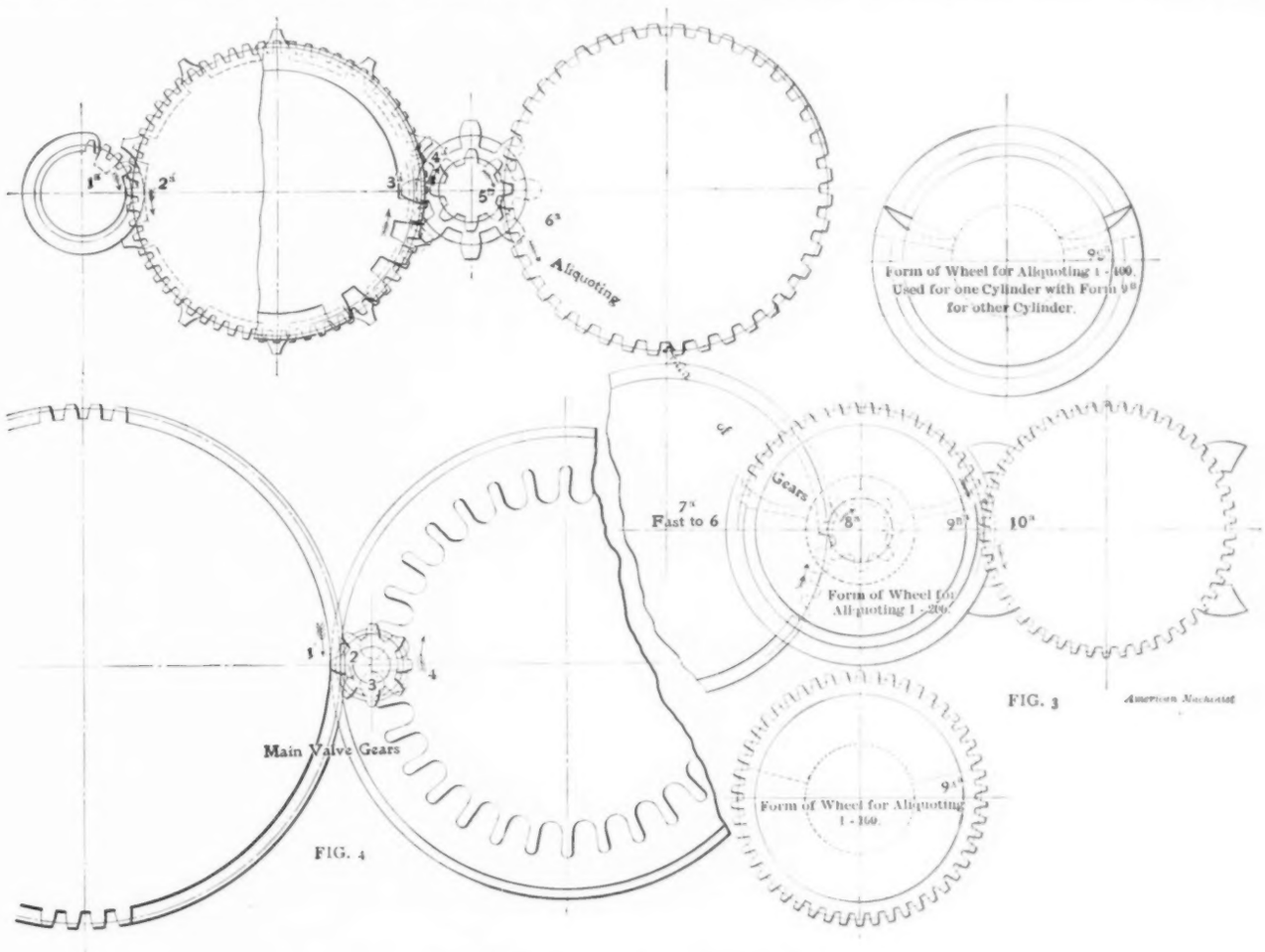
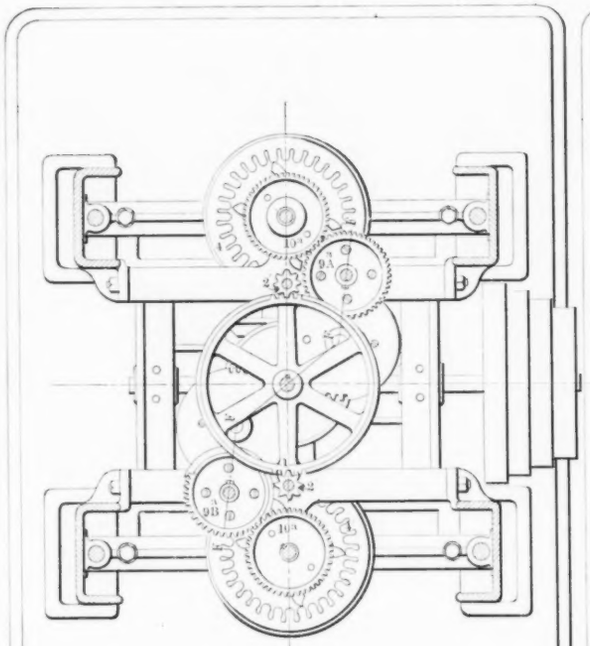

Aliquoting
Form of Wheel for Aliquoting 1 - 400. Used for one Cylinder with Form 9 for other Cylinder.
Gears
Fast to 6
Form of Wheel for Aliquoting 1 - 200.
Main Valve Gears
Form of Wheel for Aliquoting 1 - 160.

FIG. 3

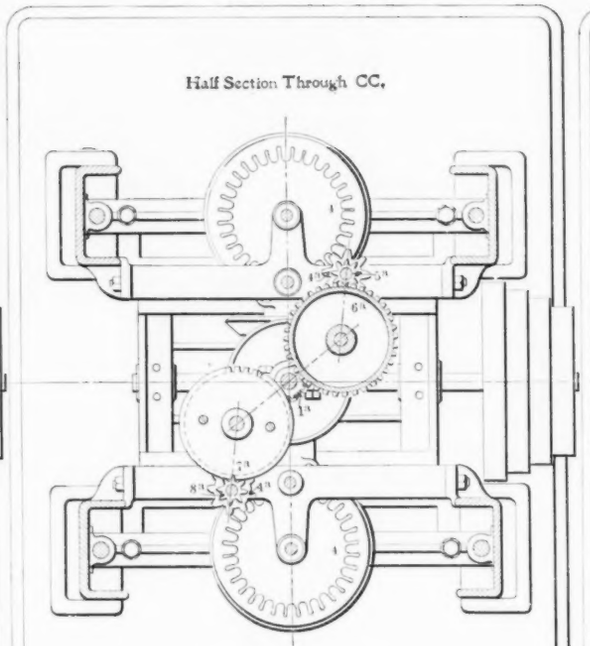
FIG. 4

ALIQUOTING GEARS FOR RESPIRATION CALORIMETER.



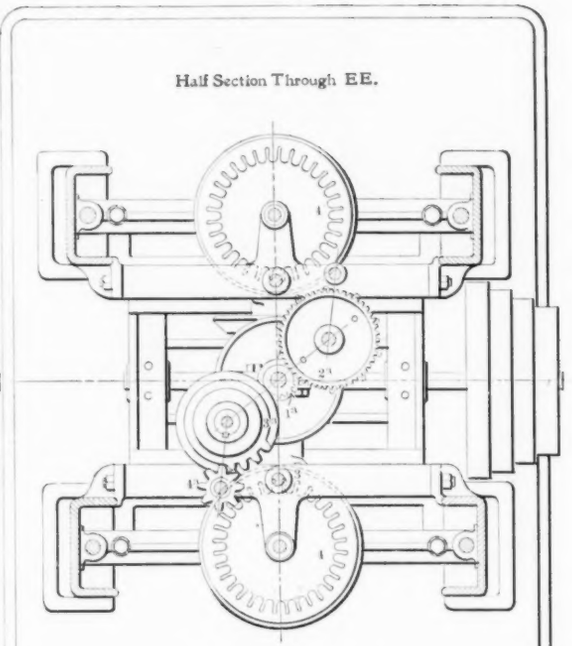
Section Through AA.

FIG. 5



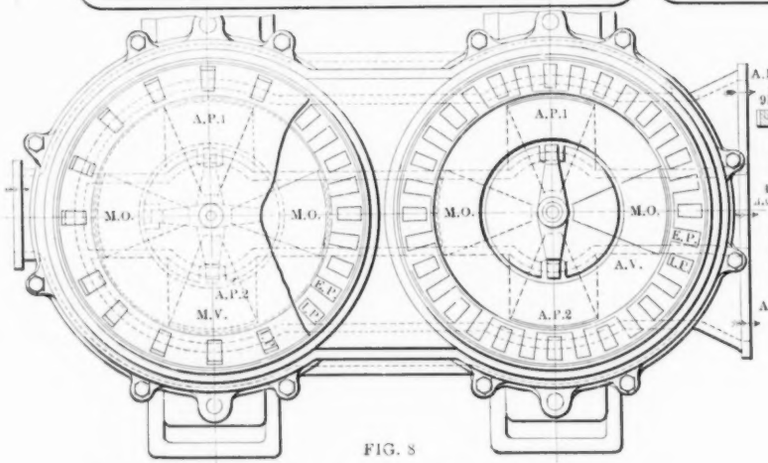
Half Section Through BB.

FIG. 6



Half Section Through DD.

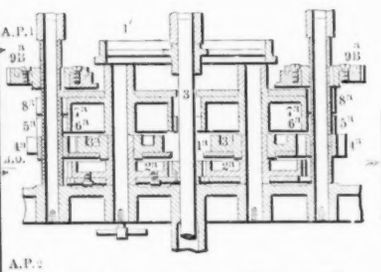
FIG. 7



Half Plan Showing Main Valve

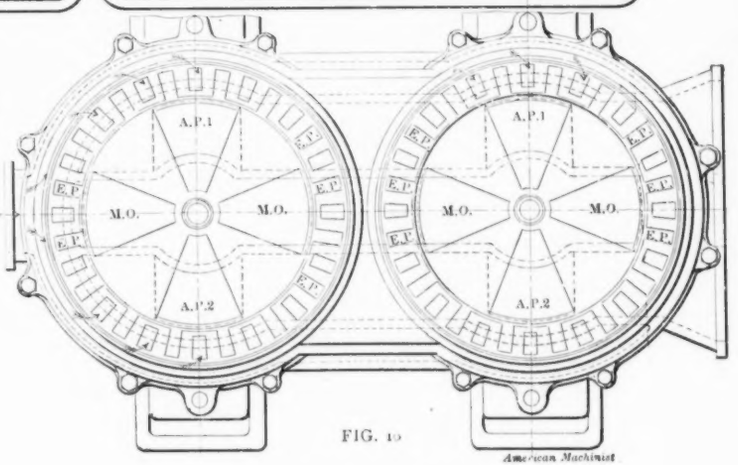
Half Plan Showing Aliquot Valve

FIG. 8



Developement of Section Through FF.

FIG. 9



Plan with Valves Removed

FIG. 10

SHOWING GEAR AND VALVE ARRANGEMENT.

wheeled American engines with four coupled wheels and weighed 30 tons. In my daily walks in pursuit of Chicago nutriment, I saw these switching engines backing up to the shops on the track which was in plain view. The question consequently came to me, "If the little engines will pull as much as the big ones, why are the little ones not used in general road service?" As the road in this location was in plain view from Michigan avenue and the engines and tenders showed distinctly in side elevation while running to and fro, it was apparent that having a short wheel base they were very unsteady. The idea then occurred to me, why not connect the engine and tender by a rigid frame and put a truck under the tender? This would give a long wheel base, with steadiness, and retain the whole weight of the boiler and engines on the driving wheels for adhesion. This was the origin of what has since been known as the "Forney" engine.

The story would be too long to tell here of the subsequent efforts to secure a patent and have it put into use, of the discouragements, of the futile objections which were made to it, of the stolid imperviousness of railroad men to the reasoning and the data brought to prove its merits, and how after ten years of the patent had expired it was adopted on the elevated railroads of New York and has been the standard engine for that kind of service here and elsewhere ever since, until now it is being displaced by electricity.

Perhaps you will excuse the vanity of a man most of whose life is behind and very little before him, and who is fond of talking, if he tells a little of the story of the introduction of this engine. The first elevated railroad in New York was the old Greenwich Steet line, which was first operated by a cable. As the cable and the company both failed, new parties took hold of the road and abandoned the cable and substituted for it little four-wheeled locomotives with inside cylinders and crank countershafts. When the Sixth Avenue line was built it became an important question to determine what kind of locomotives to use. Col. Ricker, whom many of you will remember, was then manager of the line. I, of course, considered it my special vocation to interview him and use my most convincing and persuasive arguments to induce him to adopt eight-wheeled engines of my plan instead of those with four wheels. Various objections were made to mine—one that they would not run equally well both ways around the curves of 90 feet radius, which were then and are still in use on the road. To meet this objection I had a model made on a small scale of the running gear of my engine, and built a model track with an incline and a curve corresponding to those on the road at the foot of the incline. The curve was laid off in inches of its length, so that by taking the model up the incline at a certain point and letting it run and then turning it around and repeating the operation, it could be seen which way it would run farthest on the curve, or be most liable to run off. By proper adjustment of the model it seemed to make little or no difference in the resistance on the curve or the liability of the model to run off the track, whether its truck or driving wheels were ahead. This model was exhibited to various authorities of the road and remained in my room for some weeks. The rails consisted of flat bars of iron planed on their edges and screwed fast to pieces of wood between them. The room was warm and the wood not well seasoned. One day an important authority was asked to see the model work. It ran off the track every time it was let loose. Afterwards the reason was found to be that the wood between the wheels had shrunk sufficiently to narrow the gage of the rails so much that the flanges of the wheels would not stay between them. The result was that on that occasion your embryo lecturer shrunk a good deal more than the wood had.

Finally, when the time came for ordering more engines, the board of directors agreed to refer the matter to two experts, who, if my recollection is right, were Mr. Wm. Buchanan and Mr. Octave Chanute. The decision of one of them was in favor of four-wheeled engines and the other in favor of the eight-wheeler, so we were all where we were before. It was then determined to call in ten experts, master mechanics and locomotive builders, to sit on the question. This was done and five decided one way and five the other. The company was about to order twenty engines when this tie of experts occurred. Old David Dows was a member of the Board. He solved the difficulty by proposing to order ten engines of one kind and ten of the other, which was done, but no more four-wheelers were ever ordered afterwards. The engines then came into use and your lecturer's pocket had a new thin lining added to it. It was astonishing, though, later on, how obvious the merits of the engine became to the public after the patent had expired.

It is unpardonable for a person to boast about himself, but we tolerate boasting when he talks about his children. When his progeny are about to die, if we are considerate, we encourage him to boast of them because it seems then to do him good. May I claim a similar privilege now, as the engines on the elevated railroad will soon go to the cemetery of all locomotives, the scrap pile.

My boast is of the good service performed by these engines during their many years of service. Day by day, month by month, year by year they have been in use hauling trains only a few minutes apart, stopping every few blocks, and yet how rare it is that a train is delayed by the fault of one of them. For continuous, incessant and unfailing service, day and night, year in and year out, it would, it is thought, be difficult to find their equal. Perhaps their progenitor may on this anniversary occasion be excused for being proud of them.

* * * * * * *

And now the end of these remarks is approached with a certain amount of awe. To have lived fifty years in active work is a serious matter, and a still more serious one is that it is not possible to do it more than once and that the fraction of life remaining is a very small one. Most of the events of our lives we have forgotten, although at the time of their occurrence many of them seemed to be of vital importance. That which we have still with us, with its controlling influence for good or for ill, is Character. It is the algebraic sum of our past lives, and if some inexorable and infallible account had been kept of what we have done and thought and felt, the character would be the balance left, which may be either on the debit or the credit side of life's ledger. As we approach the end we may perhaps make a few more unimportant entries to that account, but for good or for ill the ineffaceable records which we have inscribed in the day book of life stand against us, and the resultant is the most important thing that is left to us. It is not much use preaching to old sinners, but to you young men it may be said that at the end of life it really makes very little difference whether we are rich or influential, have fine houses and horses, yachts and gorgeous apparel, whether we dine on terrapin and canvas-back duck or on corned beef and cabbage, whether we drink costly wine or pure water. In fact, the more costly diet may have a potentiality of gout or indigestion, whereas the simpler food will not. To some of you younger men it may seem of the utmost importance that a particular young woman should smile on you. Perhaps it is, but if she doesn't, fifty years hence, when you may be delivering a reminiscent address like this, you will be able to regard with the greatest equanimity the fact that the wingless angel married some other fellow and is now a grandmother. If, however, in the interval which will elapse between now and then, under the mistaken idea of securing enjoyment, you should forget the requirements of the decalogue and your obligations to your fellow-men and should accustom yourselves to breaking the commands of the one and the hearts of the other, when your birthdays have vanished into the remote past, you and those about you will find you have become miserable old reprobates and the unregenerate will say that you are not worth space in Hades, only they will express the idea more forcefully.

In old age, vastly the greater part of the events of early life, including the enjoyments we had, will be forgotten; but the effect on our characters of what we have done will remain. Someone has writ-

ten that "the chief result gained by experience of life is clearness of view." It might be said, perhaps more truly, that experience gives us a more correct appreciation of the relative importance of things. To a young boy it appears to be a matter of supreme importance whether or not he should have ice cream. Later on, going skating and swimming are uppermost in his mind; then the speed of a boat and the size of his muscles may occupy his thoughts. Later, the results of business ventures seem to be the most important events in life. But in looking backward fifty years nearly all such events have been submerged in the past.

Youth, it has been said, is the springtime of the mind, the time during which the seeds of truth should be sown, because our consciousness is then lively and open to every impression. That is the time for forming fundamental conceptions and laying down the ground-work of thought. This is developed by experience and later on in life what a man has in himself is the matter of paramount importance.

But the greatest of all external compensations for the decline which comes with age is the possession of friends. Lord Bacon said that "the two noble fruits of friendship are support of the judgment and peace in the affections." With the consciousness that every friend is a blessing, I look upon this audience to-night with profound gratitude, feeling that our comradeship in the New York Railroad Club during the past years has made us friends, and in the words of the poet I can say:

"The old friends, the old friends,
We loved when we were young,
With sunshine on their faces
And music on their tongues!
The bees come in the summer flowers,
The birds renew their strain;
But old friends, once lost to us,
Can never come again."

It may be that in the future we will have occasion to exclaim:

"O, weary, weary, drag the years
As life draws near the end;
And sadly, sadly fall the tears
For loss of love and friend.
But we'll not doubt there's good about
In all of human kind;
So here's a health before we go
To those we'll leave behind."

A New Friction Countershaft.

The illustrations show a new friction countershaft designed for driving lathes, millers and other machine tools. In this countershaft both forward and reverse motion are obtained by one belt, thus doing away with the extra belt and pulleys required in the ordinary form of reversing countershafts. This makes possible a shorter and stiffer shaft, less overhead space is taken up by belts, and fewer pulleys are required on the main line. The makers claim, moreover, that this countershaft will reverse under a load quicker than a two-belted countershaft, for, as the load is always on the one driving belt, the slack and stretch of an idle belt does not have to be taken up when reversing.

The half-tone, Fig. 1, shows the complete countershaft, Fig. 2 showing the various parts. In Fig. 3 a sectional view is given, showing clearly the arrangement of the several parts upon the shaft. The reference letters here correspond with those in Fig. 2. It will be noticed that in the section both forward and reverse frictions are shown in contact with the driving pulley. In operation, however, these frictions can never be engaged at the same time, for when the shipper rod is moved to throw in one of the frictions, it releases the other, if it is not already disengaged.

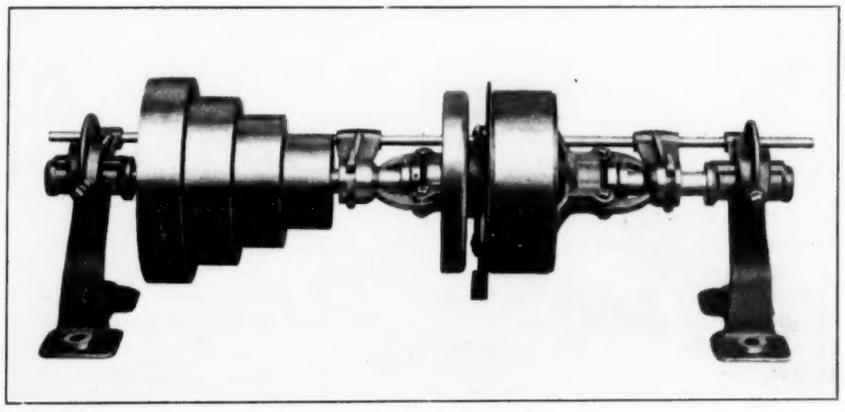


FIG. 1. NEW FRICTION COUNTERSHAFT.

Referring to Fig. 3, *A* is the shaft to which is secured a cast-iron sleeve *B*. This sleeve serves as an oil reservoir and forms a bearing for the driving pulley *C*, the enlarged end of the sleeve and the thrust bearing and collar at the opposite end preventing end movement of the pulley. *D* is an internal gear, turned on the outside to form a conical friction, and bored to slip over the hub of the pulley. *E* and *F* are frictions which are feathered to the shaft. *G* is a friction rim secured to the hub of a gear *H*, the latter being bored out to run on the large end of the sleeve *B*. On the hub of gear *H* is mounted a plate *I*, which is provided with three studs on which are carried fiber pinions *J* acting as intermediates between the internal gear *D* and spur gear *H*. Two collars *K K*, provided with adjustable rings, are pinned fast to the shaft, sufficient space being left between the collars and the hubs of *E* and *F* to allow all three frictions to slide free when not in operation. The adjustable rings on the collars form abutments for the fingers *L*, by means of which the frictions are forced against the gripping surfaces in the pulley *C* and rim *G*. The fingers are operated by the sliding cones *M*, moved by means of the forks *N* on shipper rod *O* shown in Fig. 2.

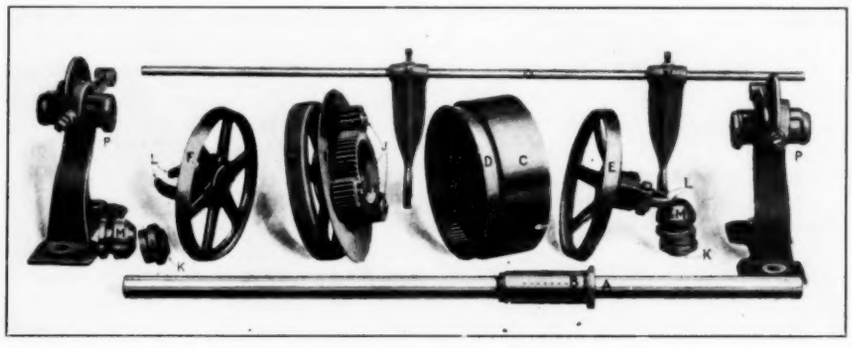


FIG. 2. DETAILS OF COUNTERSHAFT.

In Fig. 1 all frictions are disengaged and the driving pulley is free to rotate on its sleeve. When it is required to drive the countershaft ahead, the shipper rod is moved to the left, engaging friction *E* with the pulley, and thus locking pulley and shaft together. While the shaft is running in this direction, the gears *D*, *H* and *J* rest inert upon the pulley hub and sleeve.

To reverse the shaft the shipper is moved to the extreme right, releasing friction *E* and engaging friction *F* with rim *G*, and friction *D* with pulley *C*. The internal gear then runs with the pulley and drives in the opposite direction, through the intermediate gears *J*, the spur gear *H*. As this gear carries fast upon its hub the rim *G*, to which the shaft is clutched by

the friction *F*, the shaft must now rotate with the gear. The gear *H* being much smaller in diameter than the internal gear, the shaft runs on the reverse much faster than it runs ahead. The shipper, when returned to the position shown in Fig. 1, leaves both frictions disengaged and the driving pulley running freely on its sleeve.

The plate *I* is larger in diameter than the pulley and forms a guard to prevent the belt from catching between the pulley and rim *G*. It also serves as a cover for the gears, which are packed in grease that renders them noiseless and also serves as a lubricant for the bearing.

This countershaft has received the severest tests for over a year in various shops, and has proved highly satisfactory. It is the invention of Chas. F. Smith and is made by the Smith Single Belt Reversing Countershaft Company, Melrose, Mass.

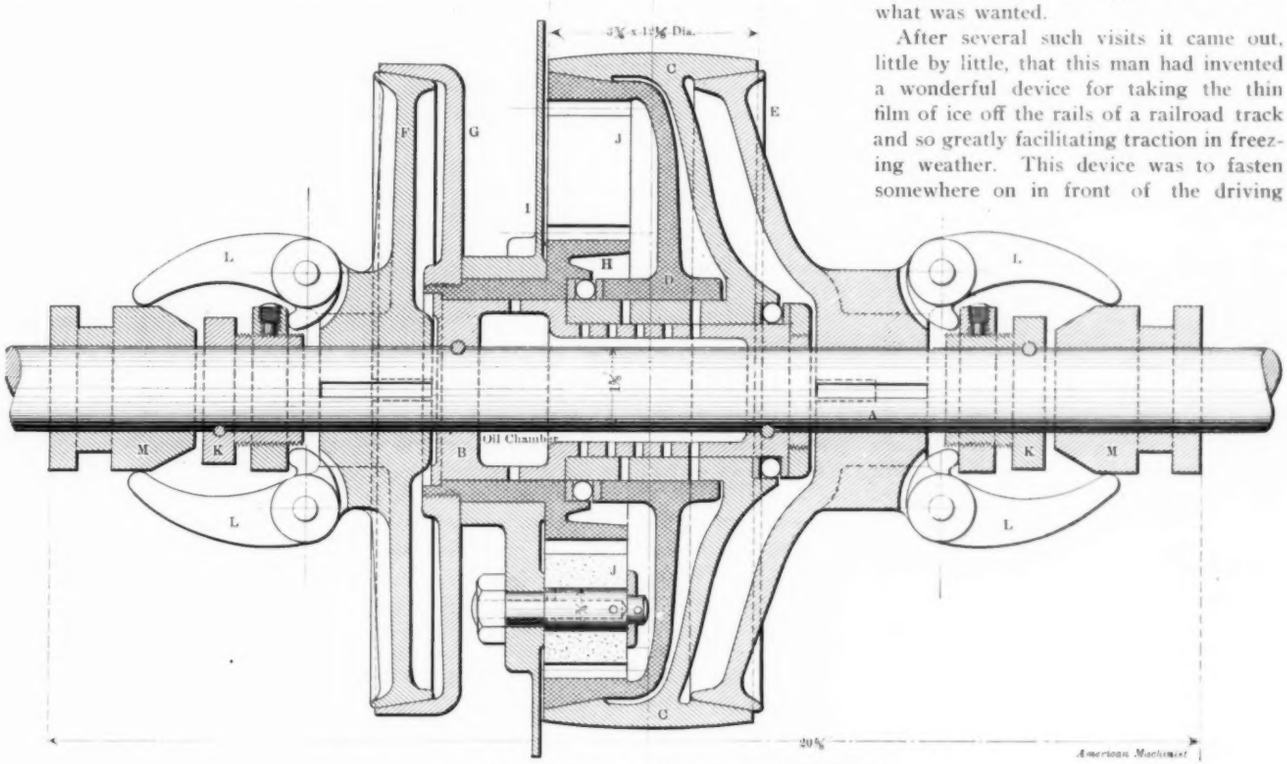


FIG. 3. SECTION THROUGH COUNTERSHAFT FRICTIONS.

Echoes from the Oil Country.

HELPING AN INVENTOR.

He was a middle-aged man. He ran a billiard room as a means of securing an income. He was a "natural mechanic," though; his friends said so, and so did he. That term "natural mechanic" brings up two—yes, I may say three—classes of individuals.

The first is the man who takes to mechanics as others take to music and whose greatest pleasure is in delving into its depths. I have had very limited acquaintance with this class, but have known a few in it.

The second class takes in those who, without any special education or effort on their part, seem to be able to grasp the principles enough to make their work valuable. With them the possibilities are much greater than the fulfillment. The number of these is quite large.

When the third class comes to mind, I often think of a boy I knew in my infancy. He was large and often quite important acting and often gave utterance to high-sounding phrases. A very slight acquaintance showed that his mind was a blank in so far as any reasoning powers went and in so far as having any power to see things in their proper relations to the rest of the world. The other boys in talking of him called him a "natural." So there is a third class of "natural" mechanics, and some of them are still met with once in a while. You may classify this one that I am going to tell you about as you think best.

His first appearance that I remember in the shop was when he was inflicted on the blacksmith. That worthy was quite a bit puzzled by his important and mysterious air, and even more so by his efforts to explain what he wanted made. It isn't always easy to know what a man has in mind by looking at a piece of bent wire and following gracefully made shapes that are formed in the air by the finger. Not knowing whether the informant has in mind a post hole digger or a burglar's instrument does not help to make the matter clear.

"How large iron shall I use for this?"

"Why! Oh! Let me see! What size would you call that?" (holding up a finger).

"I guess that's about five-eighths in the middle." And he gets a piece of five-eighths iron.

"Let me see a piece that is about six-eighths. Try that. Now I want it bent just like this wire, only it wants to be about so long when it's done," holding out his hands to show the finished length.

When that piece was done there were others; some that had pasteboard patterns and some that had to be taken away at each bend to try on something and be returned for further manipulations.

The next one to be favored with a chance to increase his stock of patience was a man at the bench, and he found it took all that he had to keep on filing and twisting without the slightest idea as to what was wanted.

After several such visits it came out, little by little, that this man had invented a wonderful device for taking the thin film of ice off the rails of a railroad track and so greatly facilitating traction in freezing weather. This device was to fasten somewhere on in front of the driving wheels and was to leave the rails absolutely clean. He had letters to show that for a device that would do this with safety and certainty a large amount would be paid. He had come to look on $50,000 as a very, very small sum indeed. To judge from some of the letters, millions were waiting on him. All he needed to do to get them was to "perfect a few mechanical details."

Not being a trained mechanic, some of these gave him trouble; still, the *idea* is the main thing, you know. Any man who is a mechanic can improve after a genuine inventor has invented the idea. He was well enough posted not to trust such people much, for hadn't he read how necessary it is to deal only with reliable firms, so as to not fall a prey to the unscrupulous. I have yet to meet a man working in a shop who ever took advantage of an inventor getting work done. That he

might not be under obligations to anyone, he always paid for all work done before leaving. Some of it took lots of time, yet I believe every man that touched his work was ashamed of the results as they left his hands.

Rumors began to reach the shop that he was putting these contraptions on the yard engines, and incidentally that the railroaders had better cigars than usual and more of them, and that things stronger than cigars could be had by a little admiration of certain devices, etc. Pieces began to come back badly twisted, and finally the place was reached where this geni s began to ask for advice, which was not freely given. Doing work one was supposed to know nothing about was one thing and helping a man to throw away his money, and perhaps wreck a train, was another thing entirely.

Inventors, the "natural born mechanic" style, are strange people, some of them, and have to be handled with the greatest of care to be handled safely. The blacksmith was a man of broad mind and keen insight, and after talking with the foreman and finding his views of the matter, that worthy decided that some steps should be taken to save this genius from himself, so he had a talk with the man at the bench, and when the next lot of work was brought in it found them ready to make an effort toward making it the last one. The blacksmith set the ball to rolling.

"It's almost useless for any ordinary man to try to make a radical improvement like you are working on. There are lots of smart men who would do the thing in such a different way that they would work all around you and you would get nothing," said he.

"You don't think there is anyone around here that could get up a thing like that, do you?" the genius asked, with a slight accent of anxiety in his voice.

"I hardly think any of our men would be likely to do it in the way you have, but we have some pretty smart men working here. That man on the bench is a thorough mechanic and he is thinking all the time. He knows lots more than you may think by looking at him. You should talk to him sometime when he is dressed up."

This evidently impressed the genius, as he was very secretive. When he got up to the bench man: "Have any of the railroads stolen your invention yet?" he was asked.

"I guess I'm in more danger from some of the lazy, unprincipled rascals around this shop that I am from the railroads," he replied, stiffly.

"You don't imagine that anyone around here has any money to waste on it, do you? It is lots easier to let you do the experimenting and after awhile to get up a good one if such a thing is wanted. I am willing to give you one pointer for nothing, though. When you make that thing float along without support, like Mahomet's coffin, you will be one step nearer done than you are now."

"I believe you have been trying to get up a machine yourself, blamed if I don't." And it did not take him long to get away with the job.

He had to get a piece that the blacksmith was forging. "Do you know, I believe you were right," he said in a confidential whisper. "That fellow on the bench gave himself away. I can see through him now, and he won't get another chance to get at my ideas. I'm awfully glad you warned me."

When paying for the job he told the foreman that he wouldn't be in any more. "I'll give this up entirely before I'll let some fellow without brains of his own steal it," he declared.

"You don't think anyone in here would steal that, do you?"

"Think it? I know it. That fellow over on the bench would have done so long ago if he had any money to work with; but he won't get any more chance."

"If all he needs is money he will soon have it. He is rich. Owns farms and bonds and has money in the bank. Just works here because he likes to and wants to wear out his old clothes. If I had half the money they say he has I would never work any more."

This was the last straw, and the inventor hastily wrapped up his treasures and fled. The last I heard of him he was posing as a hero. The world was minus a valuable invention, but he had blocked the designs of his enemies, so that made him feel good. Perhaps some day he may get his mechanical eyes open.

There is nothing like a little tact in dealing with such people. If the swelling of their heads should be reduced too suddenly the result would be disastrous. I once got the ill will of an inventor by trying it. He had a machine *in his mind* that would be grand. He knew just what it could be made for, also just what it would sell for. He also knew how many could be used in the United States. Anyone not using them when once they were introduced would have to go out of business. If the machine worked as he knew it would, the above was all reasonable enough. When the market was supplied he would have $7,000,000 profit; but to be very conservative he would only figure it as $4,000,000.

I mildly hinted that he should not expect more than two or three hundred thousand, although, to keep peace, I was willing to call it half a million. This he would not for a minute condescend to, and as that was all I would concede he expressed some very radical opinions of my good sense and judgment. The value of that idea up to date can best be expressed by the algebraic minus quantity that has to have considerable value added before it becomes anything.

Perhaps some of the inventors who have time to spare would like to perfect this ice scraper. The *idea* was to get up a device that would run close to the rails without touching them and remove any film of ice formed by rain freezing on, or by what would be left after a snow plow had done its best. While it must not touch the rails, it should come so close that the rails would be left absolutely clean. The imperfections of railroads and locomotives made some of the details needed to carry out the *idea* a trifle hard to get entirely satisfactory. W. OSBORNE.

Elevator Safety Appliances—IV.

BY WM. BAXTER, JR.

The wedge and roller safeties described in previous articles bring the car to a standstill very abruptly when they come into action. With the roller device the motion of the car is arrested within 2 or 3 inches. The wedge safety will not produce so sudden a stop because the dog that throws the wedge into action will shave down the side of the guide for a distance that may vary between 6 and 12 or 15 inches, and the wedge and car will descend as far as the dog goes. The triple grip safety permits the car to descend still further before coming to a state of rest. With slow-running elevators, a safety that stops the car suddenly can be used successfully because the safety governor can be set to act at a low velocity, and when such is the case the practically instantaneous stoppage of motion is not objectionable, considering that it only has to be contended with when something goes wrong with the apparatus. With fast-running elevators, however, a sudden stop may be even dangerous, owing to the fact that the governor must be set to act a very high velocity; hence, in such cases, it is desirable to use a form of safety that will arrest the motion gradually. The triple-grip device accomplishes this result in a very satisfactory manner, but as it can only be used with hardwood guides, it is not available for high buildings in which iron guides are provided. For such installations the most approved type of safety is actuated upon the principle of a brake that goes on with a light pressure at the beginning, which is gradually increased until the frictional resistance becomes sufficient to arrest the motion of the car. This device is known as the clamp safety, and is shown in one design in Figs. 1 to 3, this being the construction used by the Otis Elevator Company.

Fig. 1 is a plan, Fig. 2 a side view, and Fig. 3 an end view of the plank. As can be seen in Fig. 1, the jaws that form the brake clamp swing around a bolt *A* and are forced against the sides of the guide by means of the toggle links *B*. Under the center of the car a drum is placed around which is wound a hemp rope that is attached to the governor rope. When the latter rope is caught by the clamping jaws of the governor, it pulls on the rope wound around the drum of the safety and thus rotates this drum. The rods upon

which the drum revolve are threaded right and left hand, so that as the drum revolves it forces the rods out endwise and thus spreads the toggle links *B* and opens the inner ends of the brake jaws. The further the elevator car descends after the governor rope has been caught the more the safety drum is revolved and the tighter the brake jaws press against the sides of the stationary guides, until the force becomes sufficient to stop the descent of the car.

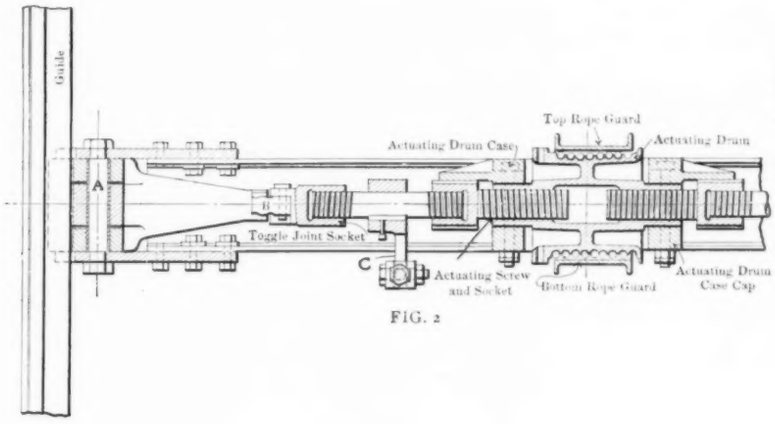


FIG. 2

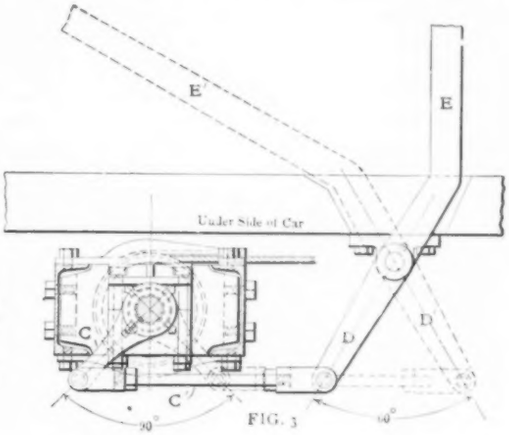


FIG. 3

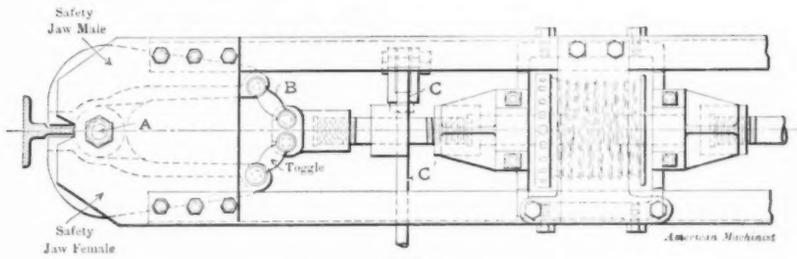


FIG. 1

CLAMP SAFETY.

At one end of the safety drum a flange is provided into which a number of holes are drilled so that should the device be called into action at any time the drum can be turned backward to its normal position by inserting a bar in these holes. The brake clamps are made so as to run with as small a clearance between them and the guide as is practicable, and on that account the total movement required of the toggle jaws to put the brakes on with sufficient force to hold the car is small, so that the pitch of the threads cut on the ends of the rods that the drum revolves around is small. To put the brakes on with sufficient force to hold the maximum load the car can carry requires about 2½ turns of the drum.

The lever *E*, shown in Fig. 3, is provided as an emergency device to enable the operator in the car to apply the brakes, if for any reason the drum fails to do the work. The lower end *D* of this lever is connected with lever *C* by means of the connecting rod *C'*. As is shown in Fig. 2, *C* is fastened to a short rod threaded at both ends, one end screwing into the casting that holds the toggle links *B* and the other end into a nut that is kept from turning by the overhanging top of the actuating drum case. The form of this nut is clearly shown in Fig. 3. The threads on the ends of this short rod are of a much greater pitch than those cut on the ends that pass through the drum, so that ¼ turn is sufficient to spread the toggle jaws as far as is required to develop the full braking force. To swing lever *C* through the ¼ turn, lever *E* has to move through 60 degrees, reaching the position *E'*.

The way in which this safety is connected with the safety governor rope is clearly shown in Fig. 4. The clamp at the top of the elevator car grips the governor rope with sufficient force to prevent its slipping under ordinary conditions, but when the governor goes into action and its grip catches the rope the car clamp is unable to hold it, and as a result the safety drum rope is unwound and the brakes go on and bring the car to a stop in a distance that may be anywhere from 1½ to 2½ times the circumference of the safety drum, according to the weight in the car at the time.

Another design of toggle clamp safety which is made by the Morse-Williams Company is shown in Figs. 5 and 6. As will be noticed, it is quite different in the details of construction from the Otis design, although the principle of action is the same. The drum guards used in the Otis design are omitted, and so is the emergency lever *E*. In place of the latter the bevel gears *K* and *L* are provided, the latter being mounted upon a short vertical shaft which terminates in an end *M*

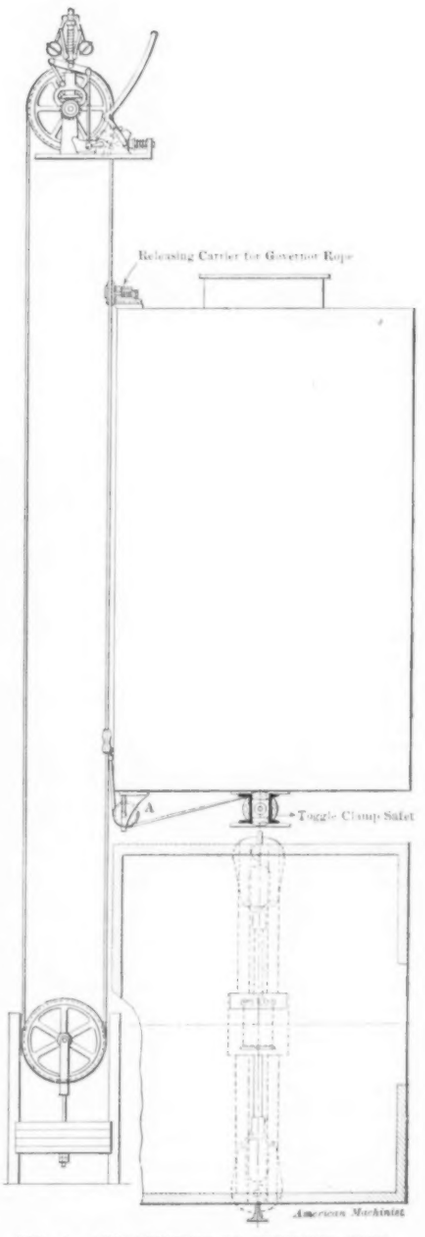


FIG. 4. ATTACHMENT OF GOVERNOR ROPE.

formed to receive a socket wrench which is inserted by lifting the plate *P*. This device cannot be used in the same manner as the emergency lever *E* and is intended simply to provide means for releasing the brake after it has gone into action. The way in which the toggle jaws are held and operated is also different from the first described design. In place of the swivel stud *A* the curved bearings *a a* are provided, and the jaws are held from spreading by means of three bolts *H*. The inner ends of the toggle clamps *A B* are forced apart by drawing the wedge *E* between the ends *D*, and springs *J J* are provided to press the ends *D* together when the clamps are in the normal position. The brake-shoes proper, which are marked *G G*, are pivoted at *d d* for the purpose of permitting the shoes to press evenly over the whole surface of the guide, as can be clearly understood from Fig. 5. The spring *C* acts to hold the clamping jaws apart so that they may not rub against the guides. In Fig. 6 the regular guide upon which the elevator car runs is drawn directly under the safety plank. In the Otis design shown in Figs. 1 to 3 no guide is shown, but they are provided in practice, and the brake-shoes do not perform the duty of guides as well as a safety device, as might be inferred from an inspection of the drawing. As a matter of fact, it would not be advisable to permit the brake-shoes to come in contact with the stationary guides, because as they must have a small clearance the amount of wear they would be subjected to if they rubbed against the guides, would soon increase the clearance to such an extent that the safety drum would have to rotate through a greater number of turns than is advisable to apply the brakes with full force.

One feature of the clamp safety that makes it very desirable for use in connection with electric elevators, and with some forms of hydraulic machines is that it can be readily arranged so as to act when the car is running up as well as when it is running down. This feature is really indispensable with electric elevators of the drum type, which is now used almost exclusively. With such machines the weight of the elevator car is overbalanced, so that if the elevator is running up with a light load the balance weight actually lifts the car, and if, while ascending under such conditions, anything should go wrong with the hoisting apparatus, the balance weight would drop to the bottom of the building and the car would be shot up to the top of the elevator well and would strike against the overhead framing with such force as to probably do serious damage. If the load in the car were great, the car would drop in the event of a runaway, and in that case the safety would have to come into action on the down trip, while with a runaway with a light load the device would have to act on the up trip. To make the clamp safety act on the up trip as well as on the down trip, all that is necessary is to provide two guiding sheaves *A*, Fig. 4, for the safety drum rope, so that the rope will be pulled and the drum unwound whichever way the governor rope may be running. In addition to this change, the governor must be arranged so as to be double acting—that is, so as to grip the rope when the speed exceeds the limit, no matter in what direction it may be running.

A double-acting safety governor, of the type used to hold the car on the up as well as the down motion, is shown in Figs. 7 and 8, the first figure being a vertical elevation and the second a plan. With this governor, if the rope is running downward on the left-hand side, the clamp at *A* will come into action and grip the rope, while if the rope is running in the opposite direction the clamp at *B* will grip it. This governor acts upon the same principle as the single-acting governor that was described in a previous article; therefore, it need not be explained in detail here.

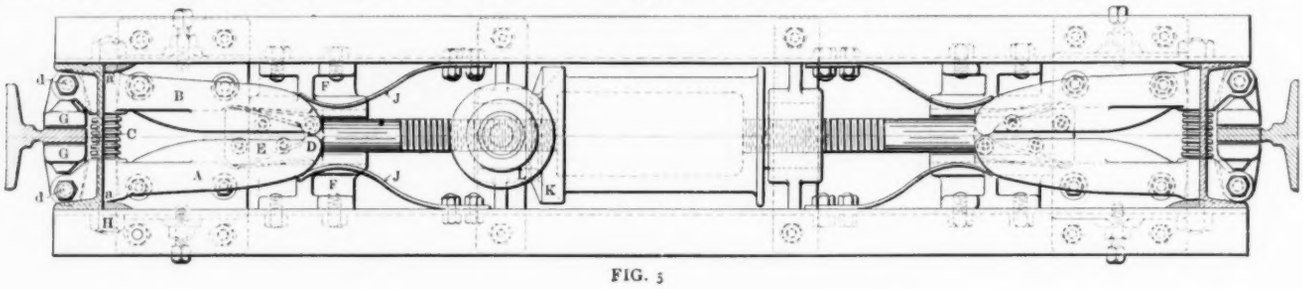


FIG. 5

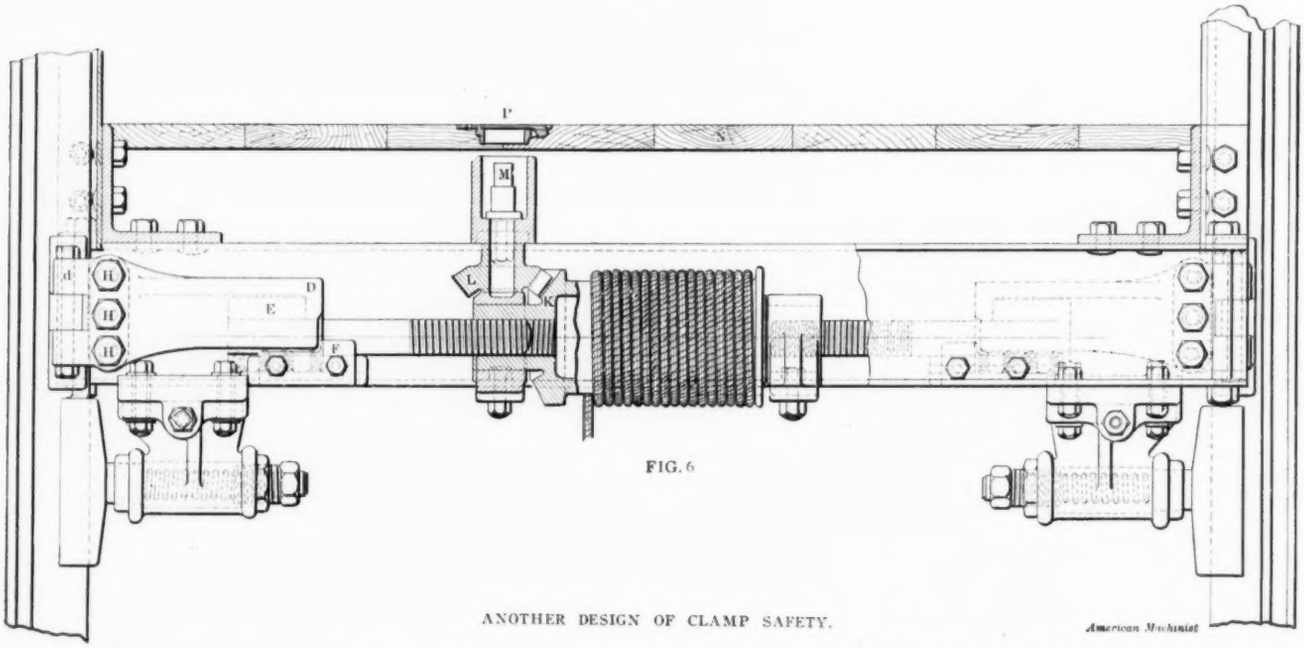


FIG. 6

ANOTHER DESIGN OF CLAMP SAFETY.

Notes on Crane Design.

BY A. D. WILLIAMS.

The track wheels have a great deal to do with the successful use of a crane. In the perfect set of wheels all will be of the same diameter, each one a true circle and therefore all will have the same circumference. In practice, the effort should be

made to have the wheels of the same circumference, even if the calipers show a slight difference in diameter between the wheels and different parts of the same wheel. It is desirable that both ends of the crane should move at the same speed, otherwise it gets out of line, consumes extra power in driving, due to binding of the shafting and grinding of the wheel flanges. In the modern crane the track wheels alone are depended upon to hold the crane in line as well as traverse it, but in earlier cranes the track wheels were used simply to support the machine, it being traversed by means of racks bolted to the runways in which gears on the crane meshed. This method was a good one, but rather expensive. The crane could not get out of line, but as a means of motion it was unnecessary and that forced it out of use.

Bridge track wheels range from 18 to 36 inches in diameter, trolley wheels from 24 inches diameter down. Wheels larger than 30 inches are seldom necessary. Double-flanged wheels are ordinarily employed, but double-tread wheels with a central flange and in some places single-flanged wheels are used. Iron and steel castings are employed. Gray iron wheels should not be used except for repair purposes, to keep a machine running. They are soft and liable to break. Chilled iron wheels are durable on a good runway. The chill should be kept from the flanges, but if the crane is to be used to pull the runway to gage, it hardly matters what kind of a wheel is used, the flanges will give out rapidly. Steel wheels will carry about 50 per cent. greater load than chilled wheels of the same dimensions. The tread, however, wears faster. The flanges instead of breaking off will be gradually rolled over on a poor runway, which, if the driving gear is mounted on the hub, forces it over and in time it will cut the track beam and cause a particularly nasty repair job.

The common practice is to make all the wheels on a crane a fairly close fit on the head of the rail, allowing only a small amount of clearance. A better method is to make the wheels on one end of the crane as above, those at the opposite end being given a tread about two inches wider. This permits variations in the runway without binding the machine, which will run easier and stay in line just as well, if not better, than with the usual arrangement.

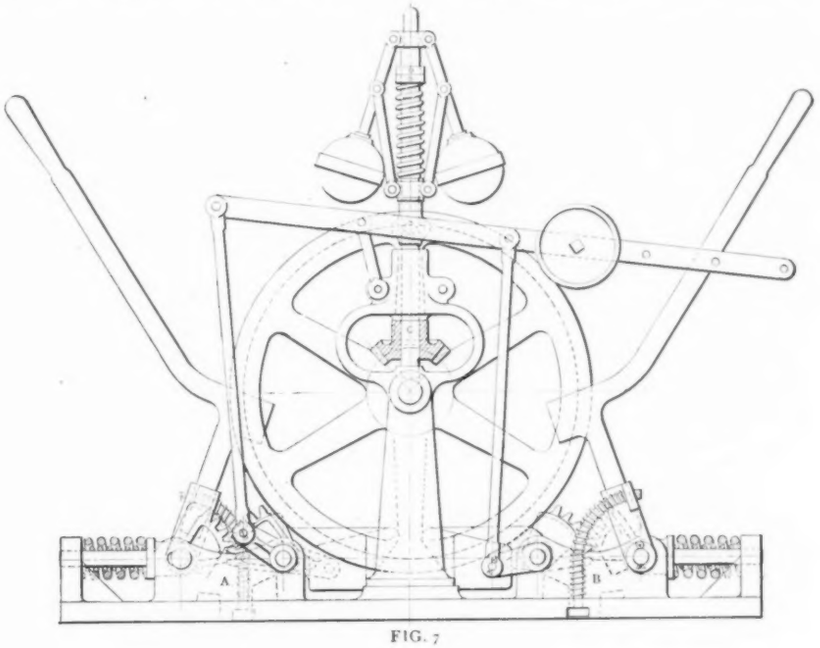


FIG. 7

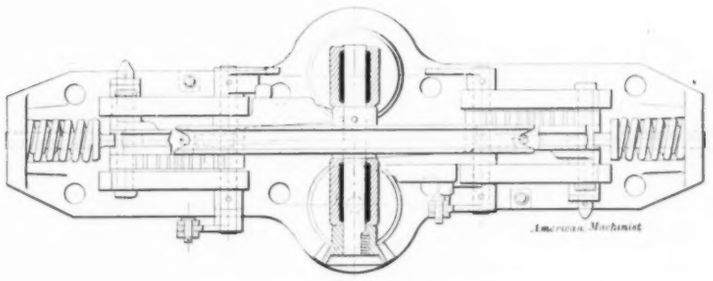
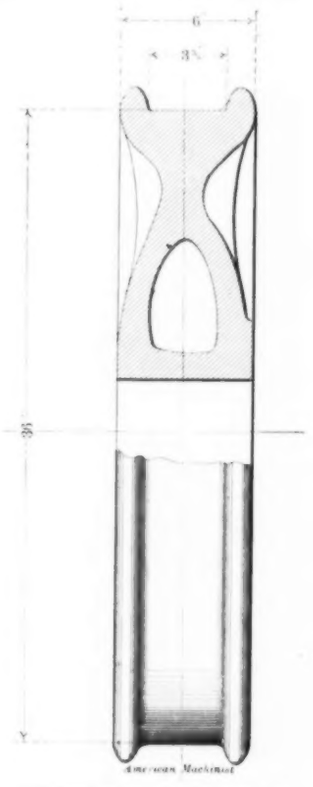


FIG 8

DOUBLE ACTING SAFETY GOVERNOR.

No general rules can be given for proportioning track wheels. The diameter can vary considerably, but the thickness of web depends on the maximum wheel load and the diameter of wheel. The web is in compression and should be proportioned on this basis. The rim must be heavy enough to carry the load each side of the center. The flanges should be from ½ to 1¼ inches in depth and should never be thinner at the root than ⅝ inch, the amount of metal in them depending upon the diameter of the wheel. Car-wheel practice furnishes a good guide to many of the details. The web should be stiffened with ribs, preferably curved, so as to produce a rotary motion in the fluid metal, which assists in securing a clean surface on the chilled tread. The hubs are usually made separate from the pattern so that they can be changed as desired to suit the case in hand. Excessively long hubs are very apt to cause hidden shrink holes or blow holes, and it is much better to use collars when necessary to fill in the space. This will save trouble in the foundry, and the expense of a bad casting in the shop will in many cases be avoided. Large fillets are desirable, particularly at the junction of the hub and rim with the web. On heavy wheels a double web can be used with advantage.



CHILLED IRON CRANE WHEEL.

The accompanying drawing gives a general idea of recent practice in designing chilled iron crane wheels. It was courteously furnished by the New York Car Wheel Works, of Buffalo, N. Y. This concern makes a large number of the chilled wheels used for this class of work.

The load on a crane wheel may seem excessive, if compared with car-wheel practice, but the conditions are entirely different. Crane speeds are relatively slow (300 feet per minute is about 3.4 miles per hour). There are no frogs to be passed and the heating effect of brake shoes does not have to be met. The maximum load only occurs when the crane is used at its full capacity with the trolley at one end of its travel; this happens only at rare intervals in actual service, but the wheel must be designed for the maximum.

In regard to current practice with crane wheels, one of 24 inches diameter and weighing 420 pounds, of chilled iron, was used on a crane whose wheel load was given as 45,000 pounds. A steel wheel of the same diameter, but weighing 460 pounds, was used on a machine whose stated wheel load was 65,000 pounds.

As to the maximum wheel load, it is hard to set a limit, except that fixed by the materials themselves, but it should be kept as low as possible. For cranes of 50 tons capacity and over, eight track wheels should be used, and this is sometimes desirable on 40-ton cranes. For lighter machines four wheels only are required. Generally only two track wheels are driven, but on heavy machines four drivers may be employed.

The weight of rail used depends on the maximum wheel load to be carried. As the rail is supported at all points by the girder, it can sustain a heavier load than when carried on ties laid at intervals. An approximate rule for the carrying power of a rail is:

$$2{,}200\,I = L.$$

L = load in pounds.

I = moment of inertia of rail.

This rule is based on the fact that it agrees with the weight of rail used in practice. The moment of inertia of A. S. C. E. standard rails is given in the Carnegie Company's Pocket Companion.

There are several methods of fastening the rails to the girders, among which are clips or washers fitted to clamp the rail down, secured by through or tap bolts. Light rails are sometimes held by tap bolts through the flange. Hook bolts can be used, which catch on the edges of the girder and pass diagonally through the web of the rail, a special washer being used. This fastening allows a certain amount of adjustment. Rail fastenings are usually spaced at 2-foot intervals.

End stops are used at the end of runway and bridge rails, being generally fastened to or formed by the rail being bent up. As the crane is liable at times to strike them with considerable violence, they must be well secured. Collisions with the end stops usually occur by accident, oversight of a busy operator, or a high wind may start a yard crane on the runway. In some places the stops are bumped to throw the crane back into line. A good stop is much cheaper than the repair bill after one has failed.

A New English Type of Universal Limit Gage.

At page 179 we published a description of a type of limit gage which had been developed by the Newall Engineering Company, of 36 Featherstone street, London, E. C. The gage there shown was intended to be adjusted to fixed bar limit gages which, as supplied, are ground to the maximum and minimum diameters for each kind of fit in accordance with a table of such fits which was included in the article. Such a system necessitates a large number of the bar gages, and we show herewith a modification of the working gage by which this objection is overcome. Moreover, the gage now shown is much more flexible than the one previously described, as the user is not limited to the allowances for fits and limits provided in the bar gages, but may vary these allowances to suit circumstances.

FIG. 1. THE NEWALL UNIVERSAL LIMIT GAGE.

Fig. 1 shows the working gage with its adjusting dial and zero in position. The pair of contact points at the left is fixed in position, but the pair at the right is adjustable by a screwdriver. One of the opposing pairs of points is intended for the lower and the other for the upper limit of the piece for which the gage is to be adjusted. When adjusting the gage both pairs of points, with dial and zero removed, are first adjusted to true size by a standard plug gage—a set of such plugs being all that is required in the way of fixed gages. The setting dial and zero—shown to larger scale in Fig. 2—are then slipped over the contact points as shown in Fig. 1, and by a screwdriver the point which carries the dial is adjusted the required amount above or below the standard to give the lower limit of size, and is then locked. The dial and zero are then reversed and the outer point is adjusted to the upper limit of size. The fit of dial and zero on the screw points is by a taper such that pressure with the thumb will fasten them in position securely enough for the purpose. The dial reads both ways from zero in order to provide for setting the gage above the plug size for a force fit

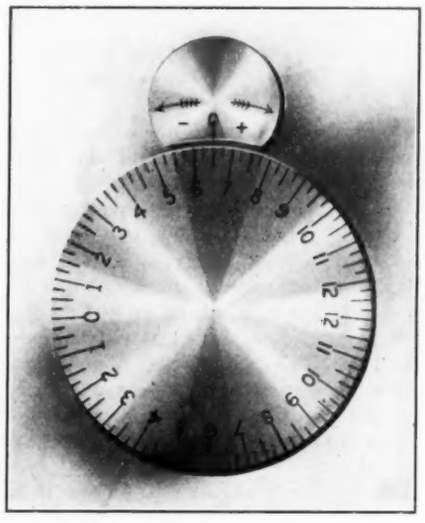


FIG. 2. ADJUSTING DIAL AND ZERO OF NEWALL GAGE.

or below it for a running fit. The divisions on the dial read to quarter thousandths.

It will be seen that by this system a single set of plug gages provides for all kinds of fits—running, driving and pressing—and for all grades of tolerance. The work may be reduced to absolute system by following a table in setting the gages, or such a table may be departed from should circumstances require it. The system is thus completely flexible. Moreover, the gages are practically free from the effects of wear. The standard plugs are used only for setting the working gages, and hence practically do not wear. Wear of the anvils or of the points of the screws of the working gages does not affect their accuracy, as they are reset for every job, and wear in the screw threads has no appreciable effect, as those screws are used for adjusting the points but a few thousandths at most.

A Piercing and Spreading Die for Box Straps —An Improved Piercing Die—A Gang Die for Box Lid Fastening Plates.

BY JOSEPH V. WOODWORTH.

At *X*, Fig. 1, is the outline of a portion of sheet metal box strap used for binding the edges of wooden boxes. These straps are produced in coils of from 5,000 to 6,000 feet, with slots pierced 2½ inches apart along the entire length. These slots are first punched and then spread to make openings for the nails. The spreading of the slots makes the openings large enough for the nails and does away with the liability of the strap breaking out at the eyes when the nails are driven into the wood. The material is 3-16 inch wide and 0.032 inch thick.

The punch and die used to produce these straps are shown in Fig. 1 with a plan view of the punch above and a plan of the die below. These tools show how very frail punches may be used for piercing sheet metal without danger of their snapping off. The metal is fed automatically by a roll feed which also straightens the stock. The capacity of this die is 30,000 feet of stock a day.

The punch consists of the stem, of cast iron; the two punch holders *C C*, of machine steel; the clamping plates *G G*, of the same; the piercing punch *B*, and the spreading punch *A*, eight screws for fastening the clamping plates and two cap screws for fastening the holders to the stem. The punch holders are located in square milled channels *F F* in the face of the stem, and are fastened in position by the screws *D*. The punches are of uniform section and double ended, and are located in seats in the holders and clamping plates. The faces are sheared so that two points will enter the stock first and thus the holes will be pierced progressively. The spreading punch *A* is beveled and rounded at the face, so as to spread the stock gradually. These punches are hardened in oil between flat plates and are drawn to a blue. They last a very long time, as they can be used from either end and ground until only a short section remains in the holder. By shearing the cutting faces of the piercing punch the clamping lid *G* holds it tightly, and it is surprising how easily the stock is pierced.

The construction of the die is of a rather novel character, and after numerous experiments it was found to be the best. It consists of the usual cast-iron bolster, with two dovetailed channels let into the face for the dies, the dies *H H* and *I I*, screws for locating, adjusting and fastening them, the stripper and gages, which are combined in one plate, and the screws and dowels for locating and fastening it to the face of the bolster.

The piercing dies fit tightly in the dovetailed channel at the right. They have slots as clearance for the fastening screws and to allow of adjustment. Pieces of 5-16 inch flat steel at each end of the channel serve as brackets for the adjusting set-screws *K K*. This way of making the piercing die allows of the faces being ground when dull with very little trouble, and insures its long life. The spreading die is in one piece and is fastened and located within the channel *J* by the two flat-head screws. In the true sense of the word, it is not a die but instead a support for the spreading punch *A*. The stripper and gages, in one piece, are machined from a piece of 5/8-inch thick machine steel, with a narrow channel milled down along one side as a gage for the stock, and widened at the left-hand end as clearance for the stock after the pierced hole has been spread. The holes in the stripper for the punches are a tight fit, this being necessary because of the frailness of the punches; the stripper is heavy for the same reason, as, in order to accomplish good results and to insure the longevity of the punches, they must never entirely leave the stripper.

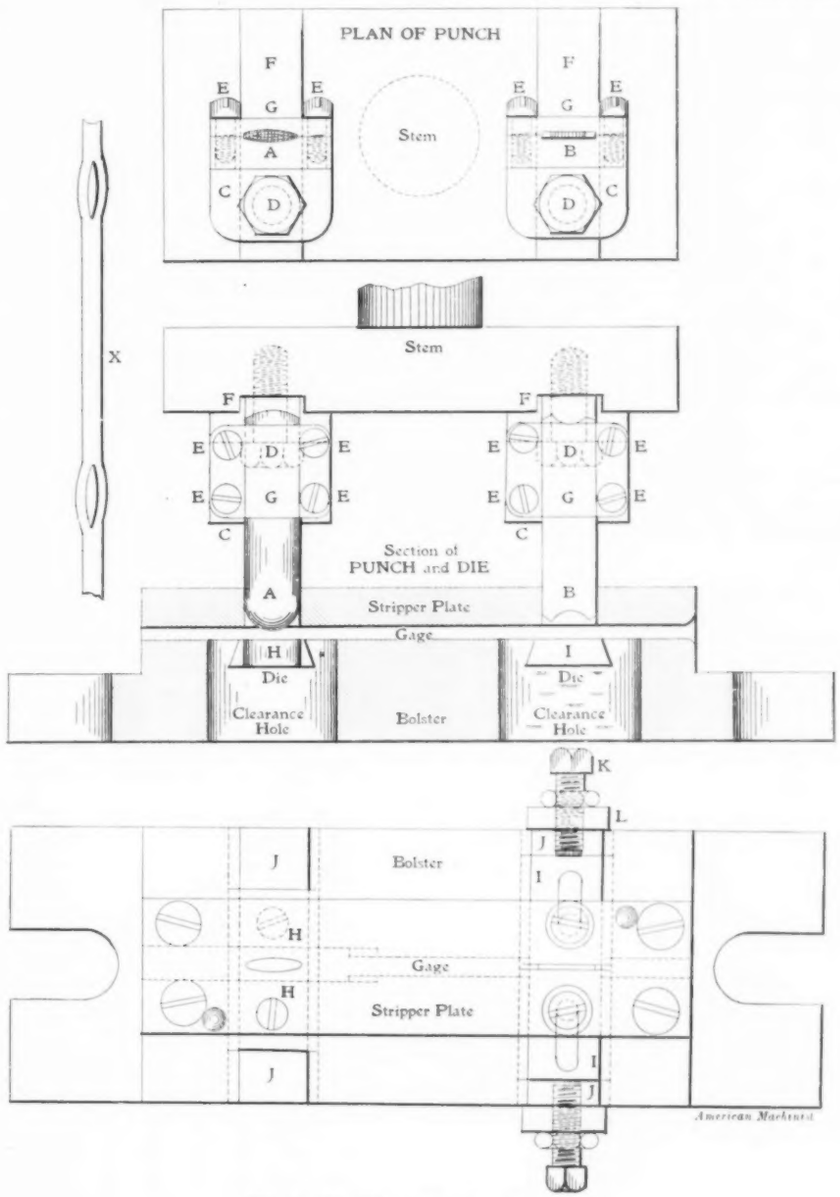


FIG. 1. DIE FOR LIGHT BOX STRAPS.

When in use the metal is fed from a reel at the right and wound up again on a reel at the left, the press running continuously for two hours without any attendance. There is a large variety of pierced work which could be produced at the minimum of cost by dies of this construction.

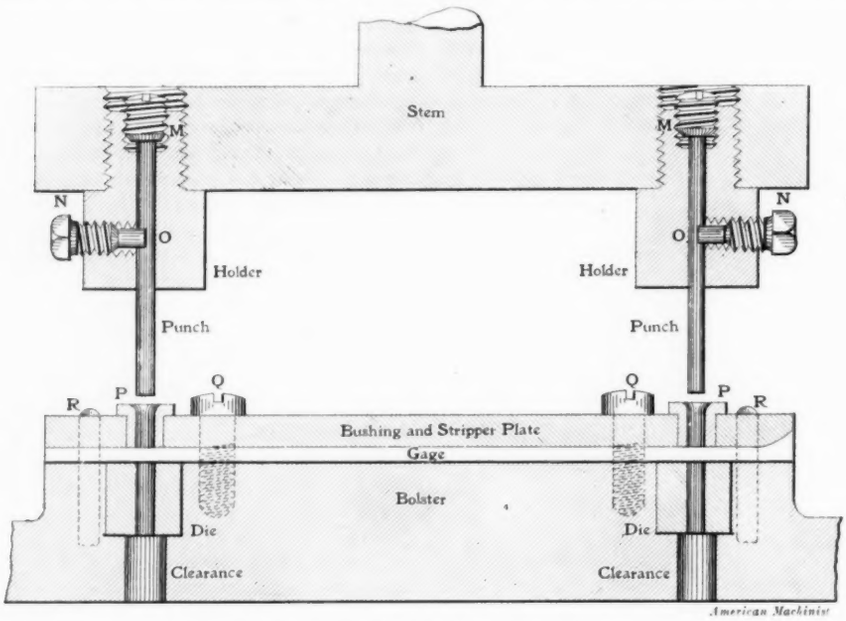


FIG. 2. PIERCING DIE FOR LONG STRIPS.

Fig. 2 shows an improved piercing die, used in the same establishment, for piercing holes in 100-foot lengths of flat cold rolled stock, ⅞ inch wide by 1-16 inch thick, feeding the stock automatically as described for the first die. The holes pierced were No. 24 gage, 5½ inches apart.

The punch pad has holes bored and threaded for the two punch holders. These holders are turned from 1¼-inch round stock, with holes for the Stubs steel punches. They are flat milled on two sides for a wrench. The backs of the punch holes are enlarged and tapped for the adjusting or butt screws *M M*. When

FIG. 3. PLATE FOR FRUIT CRATE.

the punches become short, through grinding, a piece of the same stock is placed between them and the faces of the butt screws. The punches are fastened by the set-screws *N N* and the semicircular faced plugs *O O*, thus doing away with the notching or flattening of one side of the punches and allowing of using them for a greater portion of their length.

The die is composed of the bolster, the two piercing dies, lapped and ground to size and forced into counterbored holes in the face of the bolster; the stripping plate and gages, all in one; the two punch bushings *P P*, lapped to a tight fit for the punches, and the screws *Q Q* and dowels *R R* for fastening and locating the stripper plate to the face of the bolster, as shown.

The half-tone, Fig. 3, shows a fastening plate used for hasps for fruit crate and box lids, and Fig. 4 shows the punch and die for its production. The article has three holes pierced in it, a portion of the center drawn and formed and the ends trimmed to a curve. The stock used was cold rolled sheet metal and the punch and die were of the "gang" type.

In the punch, *A* is the stem or holder, *I* the punch pad, *B B* the two small piercing punches, *C* the large piercing punch, *D* the drawing and forming punch, *E* the trimming and cutting-off punch, which trims and cuts off at *F* and *G* respectively, and *H* the six flat-head screws for fastening the punch pad to the holder.

In the die, *J J* are the small piercing dies, *K* the large one, *L* the drawing and forming die, *M* and *N* the cutting-off and trimming die, and the remaining parts the stripper and gage plate. The die plate was hardened and drawn to a light straw. The punches, except the forming and drawing punch, were hardened and drawn to a dark blue, the drawing punch was hardened and drawn from the back, getting the back soft and leaving the drawing face very hard.

The stock is fed to the die from left to

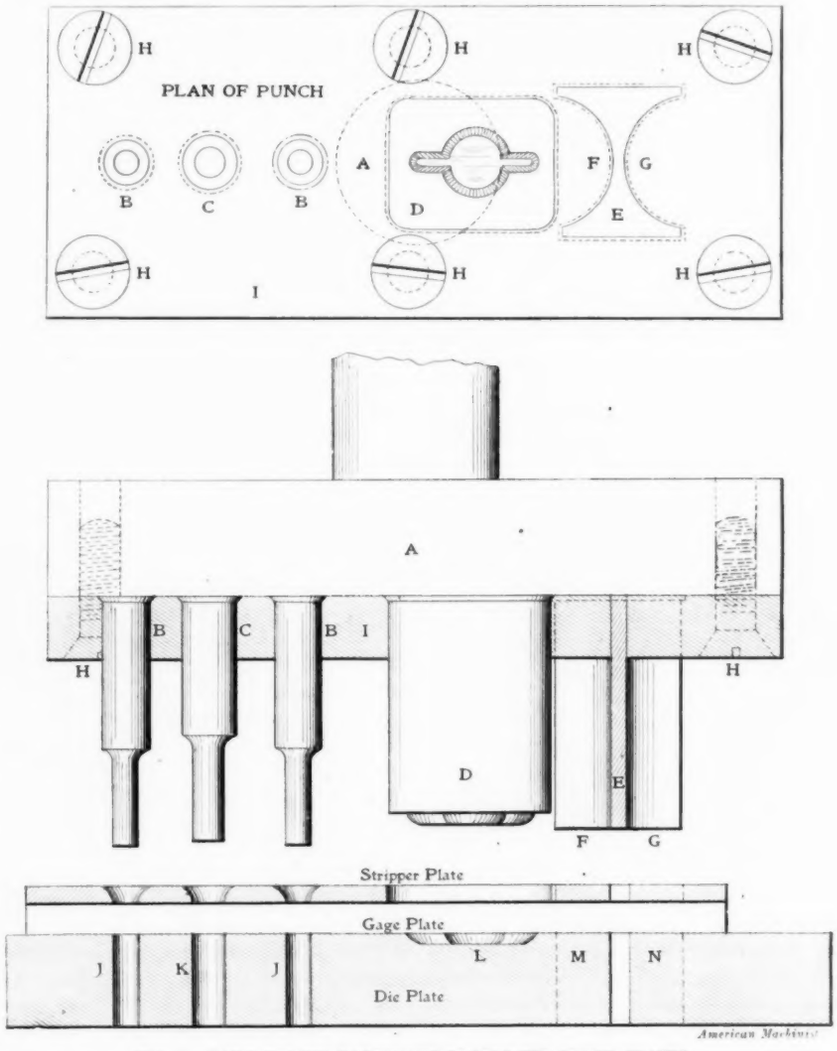


FIG. 4. GANG DIE FOR FASTENING PLATES FOR FRUIT CRATES.

right automatically, the holes being pierced first, then the formed and raised portion drawn, and, lastly, the finished piece cut off and the front end of the next piece trimmed. The drawing punch is left the shortest, this being done so that the piercing punches will have pierced the stock and the finished piece have been cut off before the raised portion of the next piece is produced; thus there is no shifting of the metal while the different operations are being accomplished. The metal used for the fasteners came in rolls of the required width. It was straightened somewhat by the rollers of the automatic feed and flattened by the flat portion of the drawing punch.

Letters From Practical Men.

Milling Machine Fixtures.

Editor American Machinist:

I enclose two sketches of milling machine fixtures which have proven very efficient with me. Fig. 1 shows a device for

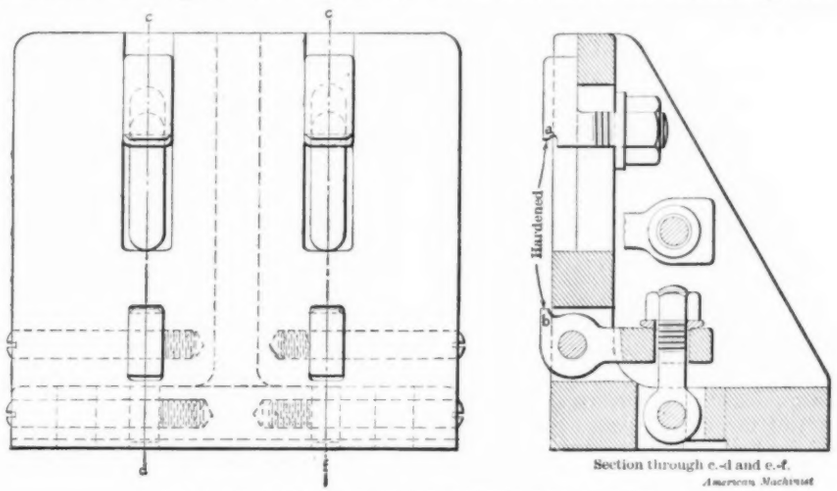


FIG. 1. MILLING FIXTURE FOR HOLDING SMALL PLATES.

holding small plates or caps, or almost anything within its capacity. The jaw *a* is adjustable vertically and may be clamped securely at any point to suit the width of the piece being operated upon. This jaw is so shaped as to obviate all tendency to spring or bend in clamping the work, thus holding it firmly against the face of the knee. The sketch shows plainly the method of clamping, the action of the lower jaw *b* being to pull the work to the face the same as the keys used on a planer. In taking the initial cut, the rough side of the work must of course be packed to prevent rocking or springing, the same as in planer practice. This fixture, in connection with a good serviceable face mill, will discount the planer or shaper two to one.

Fig. 2 shows a fixture for holding short, cylindrical pieces, such as studs, small shafts when slotting or splining, etc. It was used by me in connection with a small hand-milling machine for milling the seats for Woodruff keys. The fixture being quite short, adapts it to working quite close to a head or flange on work of that class. The nut *a* is used for adjustment only, and should be so set as to clamp the work by a very slight movement of the lever *b*. The springs keep the strap *c* up out of the way when inserting or removing the work, and the V centers it accurately. The advantage of this tool over the ordinary vise used on milling machines in handling this class of work in quantities, is plainly seen.

E. E. WINSHIP.

Cleveland, Ohio.

Give Him a Chance.

Editor American Machinist:

I have told the readers of the AMERICAN MACHINIST how much I admire an egg shell as a uniquely perfect piece of work, and of course I read with great interest Mr. Guy's article on "The Strength of an Egg Shell" at page 1222. The story he tells of the ingenious and effective devices employed to overcome the difficulties involved in the tests and of the astonishing results attained is one of the most interesting I have got hold of in a long time, and I am very sure the majority of readers must think the same. We cannot fail to have a higher appreciation of the design and construction of the familiar structure made only to be destroyed.

Another thing the writer certainly never thought of, and many a reader may have missed it, too, and that is that he was at the same time telling us of himself. It must be remembered that Mr. Guy is the author of elaborate papers which have appeared in the columns of the AMERICAN MACHINIST, notably the recent series upon the flexure of beams and farther back on the strength of flat plates, which showed him capable both of devising and of following out independent lines of experiment and deduction, and obtaining results which have hitherto eluded the world's ablest investigators. He shows himself a specialist highly endowed by nature and automatically developed to an exceptional efficiency. It goes without saying that such as he shows himself to be should have the opportunity to pursue his investigations without the necessity of toiling for bread and butter in lines that can satisfactorily be filled by men of less value to the world. It seems to me that the world is losing money by not allowing him to put himself at his best work. There are institutions endowed by men of wealth whose supreme function it should be to put within the reach of such men the apparatus and the leisure under which alone the best work of this class is done. Such as he need no one to plan for them. They can both make their work and do it to

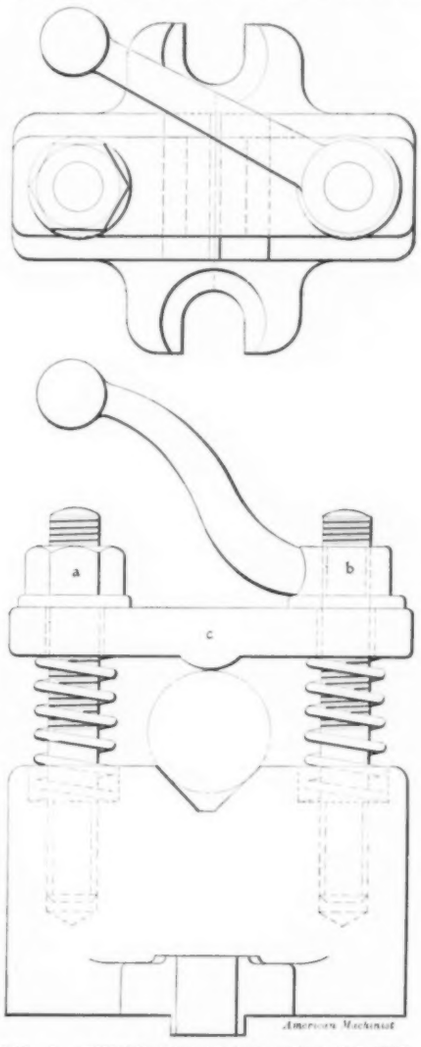


FIG. 2. CHUCK FOR ROUND WORK ON THE MILLING MACHINE.

the end if only they have the opportunity. There is a place somewhere for Mr. Guy, I doubt not, better than he has found or than has found him, and in this case the place should pursue the man.

TECUMSEH SWIFT.

Changing Locomotives Without Stopping the Train

Editor American Machinist:

Professor Sweet's rapid transit plan, described at page 1167, brings to mind a somewhat similar performance on a railroad in operation way back in the 60's in

Massachusetts, where on a local express train locomotives were changed without stopping the train.

At that time the Lexington & Arlington Railroad, a small independent line, was a branch of the Fitchburg Railroad. Some local express trains ran from Boston to Arlington without stopping, changing engines at Brick Yard Junction, where the branch line left the main line. In delivering the train to the branch line the main line engine made a "flying switch"; the engine on the branch line was already in motion and its speed and relative position to the moving train were easily regulated so that the act of coupling was readily made without jolt or jar. It should be remembered that this was in the days when automatic couplers were unkown.

JAMES B. STANWOOD.

Information Wanted.

Editor American Machinist:

Will you give me a formula or process for finding the diameter of the smallest circle that will just enclose a given number of equal tangent circles? For instance, what is the diameter of the smallest cylinder that will hold 100 1-inch round rods? or the converse, how many ¼-inch round wires will a 4-inch pipe hold?

ROBERT H. ROGERS.

Watertown, N. Y.

[As we are unable to answer our correspondent's question, we submit it to our readers.—Ed.]

An Improved Arrangement of the Hatchet Plamineter.

Editor American Machinist:

The writer of the article, "An Improved Arrangement of the Hatchet Planimeter," at page 1017, is apparently unaware of the developments which have been made in the instrument in this country, as most of the modifications which he introduces as improvements have no claims to consideration on the score of novelty, at least on this side of the Atlantic. Further, I would point out that Mr. Kleinhans' conclusions as to the nature and extent of the error to be allowed for are not in conformity with those of other investigators.

Taking the so-called improvements in order, we have, first, the provision of a pivoted handle A to allow of a free movement uninfluenced by the grip of the fingers of the operator. This is expressly provided in the British Patent No. 407, 1891, a loose socket and pivoted handle being specifically mentioned. This is Goodman's form of the instrument and has been made for many years by a Leeds firm of instrument makers. Second, the device to reduce top-heaviness has been used by Scott in his improved hatchet planimeter (*Engineering*, August 14, 1896), while Goodman uses a weight placed low down on the hatchet end of the instrument. Another arrangement for the same purpose —wherein the hatchet arm was made very much shorter than the tracing arm and the supporting surface correspondingly raised—was described by me many years ago in the AMERICAN MACHINIST. Third, the movable hatchet is almost as old as the original invention, this being one of the first and, one might add, self-suggestive developments. It is the form most generally met with in this country and will be found fully described in Goodman's 1891 specification referred to above, wherein also is described a hatchet with a depressible needle for more accurately determining the exact points between which the reading is taken. Fourth, graduated bars have been used both by Scott and Goodman. The latter in one form of the fixed length type curves the bar and graduates the scale thereon in such a manner as to compensate very closely for the error which is inseparable from planimeters of this type. It may here be pointed out that the length sought is not $A_1 A_2$, as given by Mr. Kleinhans, but the length of an arc terminating in these two points and struck with a radius $= L$ (see his Figs. 2 and 3). Goodman's plan of curving the arm to this radius enables the scale to be applied and the *curved* length read off on the corrected scale just mentioned.

This leads up to the question of the character and extent of the error to be allowed for. In the arrangement just described, the correction is that required for *circular* areas. This, however, is incorrect for any other figure, since one of the factors influencing the extent of the error is R^2, the mean square of the radii of the figure. But within the usual limits the discrepancy is not serious. What is more to the point is that the error is not a *constant* percentage of the area, as Mr. Kleinhans contends, but increases with the extent of the area measured. Thus, if the areas of a series of circles are 10, 20, 30 and 40 square miles, respectively, the corresponding percentages of error are 0.8, 1.6, 2.4 and 3.2. Hence Mr. Kleinhans' plan of shortening the scale to allow for a constant eror of 2 per cent. cannot be reliable except for circular areas of about 25 square inches.

There are other interesting developments of the hatchet planimeter to which reference might be made, but they are mainly of a theoretical character. The primitive instrument attracted attention rather by reason of its novelty than its utility, and notwithstanding the various attempts which have been made to improve its handiness and accuracy it is doubtful if the existing prejudice against it will ever be entirely dispelled. M. E.

Manchester, England.

Roller Bearings.

Editor American Machinist:

On page 1168 a correspondent writes further of roller bearings, and states a conclusion I agree with—that all parts must be hardened steel and true to size, *and the same diameter at both ends.* He goes further, however, and quotes some figures regarding the friction saving ability of these bearings which passed your inspection without comment. I doubt if Mr. Eveland had ever analyzed the figures he quotes. I may be wrong, but I think them very misleading, and that there was something back of the "government test" that was not taken proper account of. I call to mind a "practical test" of a riding plow. It was indicating a pull upon the dynamometer of 450 pounds with the common axles. New ones were put in place with roller bearings and the pull fell back to 300 or less, and the experimenter was greatly elated—a little measly roller bearing saving one-third the draft in plowing!

There were several things my friend did not take into account, and the most important one was the impossibility of the total axle friction amounting to the friction he thought he had saved, even if the roller bearings had been a mild perpetual motion motor. What was true was that the wheels on the old bearings were worn, and when the new ones were put in place, although no other adjustment was made, the furrow was different, and the machine *was doing less work.*

Taking the first two tests quoted—the common axle, asphalt pavement = 100 pounds pull; ball bearing axle, asphalt pavement, 25 pounds pull—the foot-pounds in moving 100 feet for the common axle were 10,000 and for the roller bearing 2,500—a saving of 7,500 foot-pounds in 100 feet of travel.

The weight of a good wagon is about 1,500 pounds; a load of 2,000 pounds is as much as can usually be loaded on a wagon. The axles usually are 3½, the rear wheels 48, and the front wheels 42 inches in diameter. In traveling the 100 feet the wheels will average about 8½ revolutions. Taking the formula in Kent, page 938, for the energy lost by friction of journals, .2618 $f W d n$, and assuming a coefficient of friction of, say, .06 per cent. (no reason why it should exceed .01 per cent. if properly oiled), and substituting the values above, give a foot-pound loss of 409, approximately, for each wheel, or 1,636 for the foot-pounds total axle friction on this basis. Yet this test is supposed to show a saving of 7,500 foot-pounds, which would make the coefficient of friction on the common axle at least 30 per cent. Was there not some other difference between the wagons than just the axle bearings?

Another comparison of the figures given in the same table for dirt roads makes the difference in favor of the roller bearing 160 pounds pull, or 16,000 foot-pounds difference in a travel of 100 feet, between the roller bearing journal and the plain axle. Why should a *journal* turn harder on a dirt road than on a pavement? Worse yet, on an 8 per cent. grade, asphalt pavement, the roller bearing saved 18,000 foot-pounds!

Now, if the horses are higher than the load, they must *lift* part of the load, and there being less weight upon the journals

there should have been less difference. Perhaps this difference might have been like the fly bending the 3-inch shaft "a little," as Osborne says, but it surely would be in that direction. I do not believe that "government test" will need to go into my scrap book, where I keep every item that states a fact. I have acquired about all my "technical" education from the AMERICAN MACHINIST, "Kent's Pocket Book," and experience, and I do not like to see such a little "common sense" problem slip in without comment.

Speaking of comments, why does not the steel ball shown in Mr. Eveland's bearing have the distinct advantage that it is a good pivot, and reduces the speed of the sliding surfaces half, as does the familiar step bearing disk? GEO. L. ROBY.

"Dutch" Heard from—Has a Toolroom Now.

Editor American Machinist:

Now that our toolroom is finished and has been in operation about two weeks, I think it is proper to report to the gentlemen who so strongly advocated its installation. While I feel indebted to them for the advice given, I much regret not having still more fully given the details when I made the inquiry. It may cause some surprise when I state that I wanted to cure the men of their disorderliness and slothfulness without a toolroom, but such is the fact. I had been thinking toolroom for months, and had already decided upon its size and location when it should prove necessary to install it; but I could not, and cannot now, induce myself to believe that a shop with twenty-four men, and these men doing what could reasonably be expected of them, needs a toolroom. If a man is too slothful or lazy to put things where they belong and you get someone to do it for him, is he cured? No, siree.

Now the toolroom is finished, and, as was predicted, it has eliminated much of the trouble, but I still maintain that it is an expense forced upon us by a shortcoming in our men. As we would have had a toolroom sooner or later anyway, and as the investment proves to be a good one, I am not sorry for having built it; it will the sooner yield a dividend on the money invested. Incidentally, it has caused the scrapping of some of the "impedimenta," as Mr. Tecumseh Swift terms them, and that alone is a blessing for any shop.

I would photograph the toolroom and send you a print of it, but for the fact that the partition was made of cull elm resawed, and that it is devoid of many toolroom refinements we read of occasionally, and would make a poor picture, compared with those we see illustrated now and then. But, as an old foreman of mine used to say, "it's as good as if it were nickelplated," and does the work. We built it around the miller, and the young man who runs the machine attends to the tools.

After all, I do not regret having made the inquiry. I expect to make more inquiries some time, and then I hope there won't be anyone foolish enough to think that because a man is not too self-conceited to value the opinion of others he is not capable of managing a shop. I thought of "Needle's" friend, who, when his friend put his "difficult case" before your readers, was almost eaten alive by those who thought they would have done so much better than he did.

Now that my incapability for managing a machine shop has, to the minds of some been thoroughly proven, I feel like jumping on to someone else to get even, and I can't find a better mark than "H. B.," who at page 1056 writes about that poor young chap who had a better idea of honesty than many men, including "H. B.," but who, in his own foolish and "green" way ran to the office and squealed on the men when they were conducting themselves like fools.

I have anxiously waited for some able writer to pick a quarrel with him, but, failing in this, perhaps I in my feeble way will start the ball rolling. I think Mr. "H. B." must have been one of the vaudeville actors, and perhaps (I came near saying "I hope") the one who was discharged, otherwise he might have advised the men to mind their own business as well as the boy. If "H. B.'s" disposition prevailed, this would be a funny world, and it would be the police officer and not the culprit who would be sentenced to jail. I'll say no more, except that if ever a fellow with the initials "H. B." applies for a job I'll be suspicious of him until he proves an alibi. "DUTCH."

Parallel Boring.

Editor American Machinist:

I was interested in reading the account given at page 1170 of accurately boring a hole, but would like to ask an explanation of one of the operations: that of finish boring. The article says that as the cutters were made to cut on both ends, the difficulty of making a long hole parallel was overcome. It seems to me that the overcoming of the difficulty must have depended on the fact that the lathe spindle was in perfect alinement with the shears, or, in other words, that the lathe would bore a parallel hole with an ordinary tool or single end cutter. I do not question the fact that a parallel hole was made in this manner, but would like to know what advantage the double end cutter possessed over one cutting point. THICKHEAD.

Pipe Joints.

Editor American Machinist:

Twenty-five or thirty years ago, when the *Polytechnic Review* was published in Philadelphia, they gave from time to time what they called a $5.00 idea on a 1-cent postal card. The following is worth much more than $5.00, and could be told on a postal card if it were not for my habit of stringing out the story:

We and others have had a good deal of trouble in making and keeping large threaded pipe tight, and we find that by threading the flanges ¾ inch to the foot taper and the pipe ⅝ inch to the foot that they stay all right. After settling the *fact*, it is easy to reason out *why*, as has been done in most other cases: After being threaded, the end of the pipe is thinner than farther back; this will compress, and when the thread is screwed home it is a fit all the way along. Tinning the thread of the pipe before it is screwed in is better than any paint or smear grease.

JOHN A. SWEET.

Copying Drawings.

Editor American Machinist:

There are more ways than one to copy a drawing, and better ways than copying it a line at a time. The other day I was talking to a draftsman and he was telling me how tedious copying was. It seems he had to make five drawings all alike on ordinary drawing paper, and the way he set about it was to copy each drawing line by line from the first one, which you can guess was a very tedious job and took quite a long time. This particular job, in fact, took the best part of a week, and I rather surprised him by saying that I could make four copies exactly the same as the original in about five hours. I was astonished that he did not know how to do this; it seems that some of these simple time-savers are not so well known as they should be, but then there are so many things that ought to be known and remembered that it's no wonder one is occasionally forgotten—perhaps some of the readers of the AMERICAN MACHINIST may have forgotten it. The way I copy drawings is to take a tracing of the copy on ordinary tracing paper, then go over the lines on the opposite side with a rather soft pencil (an H. B. answers very well), then the tracing is pinned down to the paper on which the copy is required and rubbed with any smooth article, an old tooth-brush handle, for instance. You will find a very fair copy can be quickly made in this way without half the risk of making mistakes that there would be were the lines transferred one at a time. After three or four copies have been rubbed off, the tracing will need to be marked over again with the soft pencil. I find tracing paper one of the most useful things a draftsman has. Its handiness in designing, when moving parts can be traced off and put through their motions, and the many other uses to which it can be put, prove it to be an article almost indispensable to the draftsman. The patternmaker also finds it very handy in marking out odd shapes which can be readily pricked off, thereby saving the time that would otherwise be wasted by transferring with the compass. I have often used it in the machine shop when marking out odd shapes, just smearing the work to be marked out with oil and sticking the tracing on. The oil holds the tracing tight enough, while you go round the lines lightly with the center-punch. CHERRY RED.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST Co., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 684,000 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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Reds vs. Yellows.

Quite a striking instance of rivalry between labor organizations has lately arisen in France and may lead to interesting results, if we may credit an account given in the *Figaro*. It appears that for some time past the fraternity of workmen in whose eyes hatred of the employer is the beginning of wisdom have been known as the "Reds," while those who believe that if enmity could be replaced by accord and conciliation all the world would run smoothly are called the "Yellows." The Yellows have been heeded and followed and their affairs are in good shape. They have organized an "Independent Labor Bourse" and daily have gathered adherents, so that at the time of the Yellow Congress last March they had 317 societies and have gained 27 since.

The Reds in looking about for means to hold up their end have invented a "Union Mark." Beginning with next winter the lodges of this order will distribute among their members cards of identification and men entering any shop where the Reds preponderate will have to display these "marks" in order to be tolerated by their shopmates. Moreover, besides the card for the workmen there will be a placard for the employers. This placard placed upon establishments whose proprietors are well disposed is intended to recommend them to the sympathies of "the clientèle" and of the workers themselves. The absence of a placard from the wall of a concern will mean "Workman, do not sell your labor here," or "do not buy anything here."

Now it is said that the Yellows are going to have their mark and their placard. So it is expected that ere long the fur will be flying.

The Speed of a Yacht.

It is claimed that Charles R. Flint's twin-screw yacht "Arrow" beat all records afloat in the Hudson River a few days ago, going at the rate of 39.24 knots per hour. The speed of the vessel is given as follows by one who is an authority in such matters. This authority says the yacht "beat her own and all other records over an officially measured course on the Hudson River, between Ardsley and Irvington, by making a nautical mile of 6,080 feet in 92 seconds, or a statute mile in a little more than 1 minute 18 seconds, or at the rate of 39.24 knots or nautical miles, or 44.13 statute miles an hour. The record was made with two boilers. Her best record heretofore was 1:37.5 for a statute mile of 5,280 feet, or at the rate of 36 statute miles an hour with one boiler."

This shows not only that Mr. Flint's yacht is a fast vessel, but that the method of calculating the speed of a vessel and of conveying an intelligible impression of what the speed is to non-aquatic readers is a complicated matter. We suspect that some of the perverse advocates of the metric system will be taking this lot of figures as a horrible example and calling attention to the much simpler plan pursued by the French when they say that a vessel travels so many kilometers per hour and say the same thing about a man, a horse, or a locomotive.

National Convention of Employers and Employees

We have received the preliminary program and circular of this convention which is to be held at Minneapolis, September 22, 23, 24 and 25. Following is a list of some of the more important papers which are so far announced:

Carroll D. Wright, U. S. Commissioner of Labor—"Is there a Solution of the Labor Question?"

Herman Justi, Commissioner of the Illinois Coal Operators' Association—"Arbitration, Its Uses and Abuses."

Frank D. Sargent, U. S. Commissioner General of Immigration—"Some Views on Arbitration."

F. W. Job, Chairman of the Illinois Board of Arbitration—"Arbitration from the Point of View of an Arbitrator."

J. B. Clark, Professor of Economics, Columbia University—"Is Compulsory Arbitration Inevitable?"

Frank L. McVey, Professor of Economics, University of Minnesota—"The Economic Effect of an Eight-Hour Day."

Jane Addams, Hull House—"Social Waste of Child Labor."

Florence Kelly, Secretary National Consumers' League—"The Indirect Employer the Purchaser."

In addition to the above, other papers with less striking titles, though perhaps of no less importance, addresses and discussions are promised from Richard T. Ely, Professor of Economics, University of Wisconsin; T. V. Powderly, ex-U. S. Commissioner of Immigration; John Mitchell, president of the United Mine Workers of America, and President Roosevelt.

The breadth of the scope and purpose of the convention is indicated by the following extracts from the circular of information:

"Among other questions, the eight-hour day will attract increasing attention. Is a shorter day desirable, all things considered? Is it feasible to adopt the eight-hour day? Or will its disadvantages be so great as to make it more of a detriment than a blessing to society?

"Shall men be permitted and encouraged to turn out all the work that they can while on duty, or shall the least efficient or the average worker set the pace for all?

"Shall business be regarded as a species of war, in which the stronger shall be allowed to crush the weaker and reap the spoils, or shall business be regarded as a new kind of partnership between business undertakers and workmen, in which each shall earn in proportion to what he contributes? In which the workman shall take as personal a pride and have as strong an interest in the business as the one who

takes the risks, furnishes the organizing brains and the capital?

"The legislative problem is always with us. We want to know what new legislation the other States have recently enacted, and how it is working. We want to know what more can be accomplished through new laws.

"But we come to the crux of the whole labor problem when we take up the matter of strikes and lockouts, and the means of avoiding them, or of settling them when they have once arisen. The cost of strikes and lockouts each year is something enormous.

"This is the price we pay for the settlement of the disputed claims of the two partners, Labor and Capital, to say nothing of the feeling of bitterness on both sides that such conflicts always arouse.

"The first step in that direction is to get together and talk the matter over in a spirit of fairness and good will. Let each side present its grievances and its claims from its own point of view, and then look at the matter when it is presented by the other side. In this way the thousands of delegates from various places, and representing various interests all over the country, will have a chance to look at the situation from different standpoints. Errors of information and judgment will be corrected, views and sympathies will be broadened. The attention of the entire nation will be directed to our industrial problems in a striking manner. When once the problem is stated in specific terms and the people get to thinking about it everywhere, the right solution is bound to be found sooner or later.

"The presence of the chief executive of the nation will make this one of the memorable events of the year. In fact the conference promises to be a milestone marking a decided advance step in dealing with the labor problem. It is going to be a national gathering of earnest men and women who represent—who are to make or mar the industrial future of this country. To be able to say that is sufficient. The success of the conference is assured. Great results may fairly be expected."

Reduced railroad rates have been secured and additional information may be obtained by addressing Wm. A. Schaper, Secretary Literature Committee, 533 Andrus Building, Minneapolis, Minn.

Queer Methods on the Elevated Railroad.

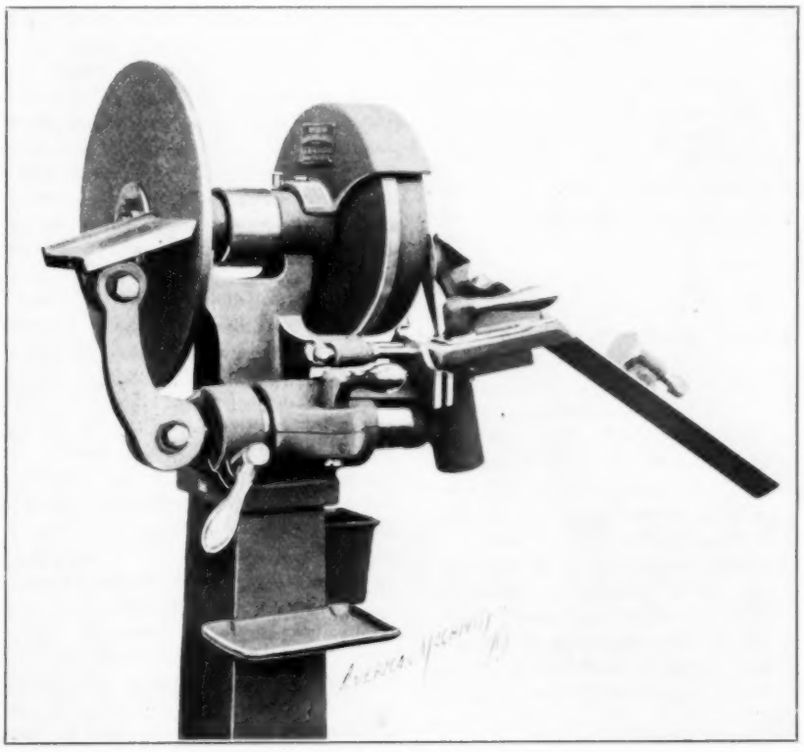
Our editorial under this title, at page 1236, contained one of those typographical errors which will occasionally escape the most lynx-eyed proofreader. The types made us say "there can thus hardly be less than a hundred of these holes." The number should have been a hundred thousand.

The Navy is carrying on experiments in the use of oil fuel on shipboard, and recently reports have been handed in on some tests made with apparatus installed in the Ocean Steamship Company's steamship "Mariposa." The average horsepower of the vessel with oil is reported as having been about 2,481, and she made a daily average of 354 knots with 278 barrels of oil per day. This is stated to have been 50 per cent. less in weight than coal to do the same work; 1½ pounds of oil per hour being sufficient to produce one horse-power. An important result was the reduction of the engine-room force from 36 to 20 men. The ship used only twelve of her eighteen furnaces, burning crude oil in two burners for each furnace and using an air compressor for atomizing, the pressure of air being maintained at 30 pounds.

Some New Things.

GRINDING AND POLISHING ATTACHMENT FOR TWIST DRILL GRINDER.

The half-tone shows the American twist drill grinder, which has been already shown in our columns, with an addition to it which should greatly increase its usefulness in certain lines of work. The addition consists of a disk placed upon the other end of the emery-wheel arbor, the disk to be covered with emery cloth, and a universally adjustable work holder, the entire arrangement clearly explaining itself. The attachment is so made that it can be placed upon any of the machines that have been sent out. It is made by L. S. Heald & Son, Barre, Mass.



GRINDING AND POLISHING ATTACHMENT FOR TWIST DRILL GRINDER.

Workmen's Homes in Essen.

At the time a number of participants in the Marine Congress at Düsseldorf were allowed to visit the Krupp works in Essen, they had opportunity to inspect the arrangements that have been made by this firm for the personal accommodation of its employees. A description of the dwelling houses built by the big steel concern is published in the *Deutsche Metall-Industrie-Zeitung*, from which we give a free translation.

The particular group of visitors whom the reporter accompanied examined, among others, the Kronenberg Colony, an old dwelling place largely constructed in the years 1872-74. The buildings comprise in part rows of three-story houses with 30 to 40 dwellings or apartments, and in part detached three-story, double houses with 12 apartments. The structures are plain, yet in the middle of the colony is a park connected with the gardens of the houses, giving the premises a landed appearance.

Further on, were found the lodging houses for unmarried workmen. They contain on the average ten men. A housekeeper looks after the housheold. In the dwelling is a reception, a billiard and a dining room. The sleeping rooms are constructed according to modern science and so as not to be shut in by surrounding buildings. The cost to the inmates is 1.6 marks (about 40 cents) daily, or 1.75 marks if they have a bedroom for themselves. For first breakfast they have bread spread with butter, which in Germany is considered quite a luxury. It is not ex-

plicitly stated whether their entire table board is included in the sums named.

A very favorable impression is made by the Alfredshof colony, which was built the year 1894 according to the cottage system. It contains houses for one to four families each and two large rows of houses. Each house stands in a little garden. The single family houses have five rooms, the apartments in the other houses three to four rooms. The present number of inmates is 232.

The youngest of the Krupp workman colonies, the Friedrichshof, begun in 1899, is arranged on the city flat-house system because of the dearness of land. Yet here also hygienic considerations have been held in mind as far as possible. Six or perhaps four families have an entrance and staircase in common, three or two use the same laundry. Most of the dwellings are joined in large blocks. These are grouped about three great broad courts which are provided with garden plots and playgrounds; light and air have free entrance. Up to the present time buildings comprising 200 dwellings have been erected at Friedrichshof.

In the Kronenberg colony before mentioned there were, in 1901, 63 dwellings intended primarily for master workmen and office employees. These answer still further requirements. They contain four to eight rooms. For each three dwellings is a spacious laundry with a bleaching place. The houses are in exceedingly good taste and rendered attractive as well as useful with gables, etc.

In May, 1900, there lived in the Krupp houses 8,212 employees, with 18,466 dependents, in all 26,678 persons. The number of employees at the Essen plant was over 27,000, so that the proportion "in barracks" was not especially great.

Finally, these members of the Marine Congress had opportunity to view the Altenhof invalid colony, which lies about an hour south of the factory. This colony was founded in 1892. The apartments are for the free lifelong use of old and invalid workmen. The inmates are chosen according to worthiness and need. The arrangement of the dwellings is essentially the same as at Alfredshof. The single and double houses lying in little gardens contain one, two or three 3-room apartments. In the widows' quarters the principle of adjoining rooms is abandoned, since in these there are apartments of two rooms, one above the other. Among the further buildings there is a house for twelve special pensioners and one for six widows, in which the inmates each have a room and share a kitchen near by. The number of inmates is 191. There is a Catholic and a Protestant chapel, described as true gems. Moreover, there is a house for convalescents in the thick of the wood surrounded by a beautiful park.

The foregoing account does not assume to cover all that the Krupp firm is doing for the welfare of its employees, but has confined itself to the most essential department—that of dwellings.

Progress in Gas Engines and Gas Power.

The present condition of gas power is one that many scarcely appreciate. Gas engines are being made to-day of 500, 1,000 and even 2,000 horse-power for the use of either producer gas or blast-furnace gas, and there is as little trouble in starting these engines as though they were steam engines. There have also arisen numerous makers of gas producer plants. All this indicates progress, more or less diversified, as is all progress, by occasional failures. Probably more can be learned from failure than from unalloyed success.

If the failure of any gas power plant be fully investigated, it will probably be found that the chief trouble has been in premature explosions. In a gas engine of small size a premature explosion probably represents less than it does relatively in a large engine. One thing is certain, and that is that these early explosions are destructive of regular turning effort and are apt to be far more serious in an electrical station than in any other. A single wrong explosion means dim light, and in a power station it is fatal to alternating current machinery in parallel. Premature explosions must be prevented. To do this we must first know their cause.

It is of course well known that a gas or oil or petrol engine will work without any intentional means of ignition. The points of the electrical spark apparatus or some other easily heated projection will become so hot that they will continue to ignite the compressed charges after the spark has been put out of action. If the degree of compression of the charge could then be increased, ignition would occur earlier and a premature explosion would result. To avoid such mishaps it is essential, of course, to avoid all projecting and more easily heated pieces in the cylinder and especially on the piston, which, not being water cooled, is more easily overheated than the jacketed cylinder. We are thus brought face to face with two of the difficulties of the gas engine, cylinder cooling and compression of the charge. It is evident that the cylinder must be cooled below the point at which premature explosions can occur. Further, compression of the charge being a cause of economy, it must be kept moderate so that the compressed charge shall not be prematurely exploded. These two, cooling and compression, must be compromised and serve to explain the very moderate compressions in petrol motors.

There are only two of the elementary bodies which are of use as commercial fuels, namely, hydrogen and carbon, and these two substances, in various combinations, are the constituents of all the solid, liquid or gaseous fuels. Of the two, the avidity of hydrogen for oxygen is much greater than that of carbon, and, moreover, hydrogen will ignite at a less temperature than carbon, and these two qualities appertain to fuels that contain hydrogen as compared with those that do not contain it. Thus the hydrocarbon gases burn more readily than carbonic oxide, which is the main constituent of most producer gas. Similarly is it not common knowledge that the smoke of bituminous coal will burn with air and deposit carbon in the form of soot? Here the hydrogen burns at a certain low temperature which is not sufficient to enable the carbon to burn. If the action takes place in the presence of a sufficient amount of air at a sufficiently high temperature the carbon burns just as perfectly as the hydrogen.

Now, all the first gas engines worked with illuminating gas containing considerable hydrogen, and the fault of premature explosion was common. Then producer gas came along. It was made from coke or anthracite and contained little or no hydrogen, but only carbonic oxide as its combustible constituent. A certain amount of carbon dioxide also probably tended to make the gas but little combustible, and it became possible to use very much higher rates of compression than when the gas contained much hydrogen, and the poor gases, as the French call them, could be used with considerable economy. The poor gases were considered so poor that an effort was made to improve them by the use of steam in the producers. Hydrogen was produced in considerable quantity, and again we have an easily ignited gas which will not permit of too severe a compression. Thus it is that water gas engines, oil engines and petroleum engines can none of them be worked at such a high degree of compression as is possible mechanically and desirable economically. Even the less readily ignitable carbonic oxide cannot be seriously compressed, though it is much safer than a gas containing hydrogen, and the internal combustion engine is thus very seriously crippled and possible economy becomes impossible.

Much has been made of the cycle of the Diesel engine, and the economy of this more novel engine has been laid to the approximate resemblance of its cycle to the Carnot cycle. I do not think that thermodynamics has very much to do with the heat engine in any practical shape. Cylinder action too much interferes with the thermodynamic laws for us to seriously consider these in connection with economy or general behavior. All the same, the Diesel engine has one feature which should make it very welcome to the water gas producer men and to all who believe in the future of power gas and the gas engine. There is no compression of the charge in the cylinder of the Diesel engine. There is compression to a very high degree, but it is compression of simple air. The compression is to 35 atmospheres, or

fully 500 pounds per square inch. Such a compression raises the air to a red heat. Into this highly heated air oil is sprayed by means of a jet of still more highly compressed air. There is no reason why gas should not be used as the fuel. It would of course require to be compressed above the compression in the cylinder, so that it could flow to the cylinder through a suitable admission valve; but the principle is the same. The fuel is admitted gradually and burns in the heated air. There is no explosion. The initial pressure does not even rise above that of the compression. The burning of the charge simply increases the volume of the gases in the cylinder, and these gases expand along a curve of higher pressure at each point than the curve along which the air was compressed and work is done. Volumes may be written of more or less intelligible thermodynamics on this peculiar engine. The main practical fact is that the degree of compression can be anything that economy may dictate or practical construction render possible. There is no limit set by fear of premature explosion, for there is no explosion in this engine, but merely a combustion, and even this combustion can only occur when the admission valve opens to admit the fuel to the heated air that awaits it. Here, then, is a safe engine and one that can be trusted to run without risk. It is an engine that should be studied by all gas engine and gas producer men, not because of the economy claimed for its peculiar thermodynamics, but entirely because of its mode of fuel admission, which renders so much else possible. An ordinary engine with so high a compression would not work, for its charge could not remain unexploded at the accompanying temperature. Unless this or something similar can be employed we should be face to face with the fact that the hydrogenous gases, such as we get from bituminous fuels, would be unsuited for use in the more economical types of gas engine. The only gas would be carbonic oxide, and the gas producer would be confined to the use of coke or anthracite and could never become the universal agent of power production that it is now likely to become. The production of power gas has become so much associated with the by-production of ammonia that mere carbon gases will not entirely hold the field. Hydrogen is a powerful gas and will enable an engine of a given size to do much more work than the less powerful carbon gas. But too powerful a gas is not by any means an unmixed blessing in an explosion engine. There can be no objection, however, to the use of hydrogen when it is fed into hot air and burned instead of being exploded in bulk.

Whatever may be the ultimate form of the gas engine, it is certain that its success depends largely on the excellence of its mechanical construction, and, as in many other things that have once failed but are later made into successes, the gas engine is largely a creature of the machine tool, on the excellence of which, to a great extent, the modern gas engine must depend for its own excellence.

Air Ships Under Construction.

The science of aerial flight now commands wide attention in Europe and America, and the magnificent prizes aggregating $150,000 offered by the St. Louis World's Fair in connection with aerial navigation have stimulated experimental work throughout the world. Many airships are in course of construction and some are ready to begin their experiments, notably the "Santos-Dumont" Nos. 7 and 8 and the "Ville de Paris," which belongs to M. Henri Deutshand and is being built by M. V. Tatin. It is probable that this "dirigible" will be able to begin experiments at the end of the summer. In the village of Moisson, near Nantes, an immense building shelters the "dirigible" of Pierre and Paul Lebaudy, built from the plans of don Simoni. This airship will be ready to leave its shed at the end of the month. In the Park of Vaugarara M. de Bradsky hopes to be able to experiment with his "dirigible" in a couple of months. Many others are working on the problem, for example: M. Tur, at Courbevois; M. Louis Pillet, at Vincennes; M. Roze, Colombes; Messrs. Smitter and Debayeux, at Vincennes, and the "Mediterranean II" of M. Henry de la Vaulse, who will continue, in September, his very interesting experiments in maritime aeronautics. In Brazil Jose de Pabrocino seems to work seriously on the same problem.

Technical Publications.

We have received the first issue of *Page's Magazine*, an English technical journal devoted, according to its own announcement, to "engineering, shipbuilding, the iron and steel industries, electricity and mining," a field certainly vast enough. It will be "essentially an English production, with the advantage of American ideas and methods." It does "not believe in a decadent England." The articles seem to have been selected with a view to covering the topics enumerated in its announcement. It is handsomely gotten up and properly illustrated with half-tones almost exclusively. It is too early to criticize the material furnished. We wish it the success it has set out to win.

"Worm and Spiral Gearing." By F. A. Halsey. 85 3¼x6-inch pages, with 23 illustrations. Van Nostrand Science Series No. 116. D. Van Nostrand Company, New York. Price, 50 cents.

This book is a republication of the articles on Modern Practice with Worm Gearing, which appeared in our Vol. 21, and those on Spiral Gears, which appeared last year. The former articles explained the theory of the influence of the thread angle upon efficiency and durability, and showed by numerous examples of successful and unsuccessful worms that experience fully corroborates the theory. The latter articles are too recent to need calling to mind.

"The Treatment of Steel." Third edition. 152 4¾x6¾-inch pages, with illustrations. The Crucible Steel Company of America, Pittsburgh, Pa.

Many of our readers are already acquainted with this book, and those who are not should be. It is a thoroughly practical book on its subject, which no worker in steel should be without. The present edition contains considerable new matter, among which is a chapter on self-hardening steel. A copious index has also been added. The book is published "for free, judicious distribution."

"A Graphic Method for Solving Certain Questions in Arithmetic or Algebra." By G. L. Vose. Second Edition. 62 3¾x6-inch pages, with 28 illustrations. Van Nostrand Science Series No. 16. D. Van Nostrand Company, New York. Price, 50 cents.

The increased attention which is being devoted to graphical methods makes the second edition of this manual even more timely than the first. The problems considered are not of the class with which our readers have become familiar through the numerous diagrams which we have published from time to time, but are of the class of which single definite solutions are possible and which are usually solved by equations made up to express the given conditions.

"Induction Coils for Amateurs." Edited by Percival Marshall. 70 5x7¼-inch pages with 35 illustrations. The Model Engineer and Amateur Electrician, London. Price, 6 pence.

This pamphlet is an excellent publication for those who like to undertake the construction of home-made apparatus. The principles and action of induction coils are clearly though simply shown and the explanations really explain. Very limited facilities are presupposed, and we can see no reason why any ambitious amateur may not make all of the apparatus described and obtain satisfactory results with it. At the conclusion is a chapter describing the experiments which may be made with the coils. Publications of this class are a striking illustration of the extent to which amateur work is carried in England—a practice which we could wish might be imitated here.

A reader wishes information as to the best method of turning and polishing hard rubber.

The U. S. cruiser "Des Moines" will be launched from the yard of the Fore River Ship and Engine Company, September 20.

Recent figures show that there has been a considerable increase both of exports

and imports of manufactured articles. Articles of iron and steel have been exported in less quantities of late, but exports of other manufactured articles, including especially cotton cloths, have greatly increased.

There has been some likelihood that the Machinery Hall of the Paris Exposition at Champs de Mars would be demolished. However, at an interview of the bureau of the Municipal Council of Paris with the group of Deputies of Paris the latter were all opposed to the destruction, though reserving the question of its removal to another site.

Tool holders for inserted tools are probably not used in America as extensively as in Europe, especially in the larger sizes. We do not know just how large such tools have been made abroad, but they seem to be running to larger sizes here than would have been supposed practicable. We learn that the Western Manufacturing Company of Springfield, Ohio, has recently supplied such tools to the Newport News Shipbuilding Company, the Wellman-Seaver-Morgan Engineering Company and others, in which the shank of the tool was 3 inches square, 30 inches long, using a cutter made of 1½-inch square steel, and the whole tool weighing 125 pounds.

Personal.

Our contributor, Mr. D. E. McCarthy, who for some time past has been connected with the Westinghouse Electric & Manufacturing Company, latterly as general foreman, has left that position to accept a place with the American Arithmometer Company, of St. Louis, Mo. His leaving his position in Pittsburgh was made the occasion of a farewell dinner, smoker and entertainment tendered him by his associates in the Westinghouse establishment, during which he was presented with a handsome silver service suitably engraved.

Commercial Review.

NEW YORK, September 8.

Perhaps there is nothing which better demonstrates the prosperous condition of the machinery trade than the absence of the keen competition which characterized it several years ago. It can almost be stated as an axiom that when business is dull competition is brisk.

From statements made by manufacturers of machinery, it would seem that at no time was competition so meagre as at present, the only exception being woodworking machinery, which has already been discussed at length in these columns.

One of the principal reasons for this gratifying condition of affairs, is the fact that the manufacturers have so many orders on their books that they are more desirous of executing them than they are of adding to them. They are prompted to adopting this policy because of the delay incident to deliveries, for which a variety of reasons, many of them too obvious to mention, is responsible.

A manufacturer in speaking of the absence of keen competition in the machinery trade said to the writer: "It is not so very long ago when the announcement was made that certain machinery was wanted to find twenty concerns, frequently more, anxious to obtain the order. You don't find this nowadays. During the past year I have sought many orders with the expectation of finding many of my competitors bent on a similar mission, but have been surprised to see only three or four of them bidding against me. This is simply because everybody seems to have all he can do to fill existing orders, and is not very anxious to book new ones. In fact, nowadays it's just a case of letting people know what you have to offer, and they'll do the rest."

The announcement that the American Bicycle Company had defaulted in the payment of the September interest on its debenture bonds, followed as it was by the appointment of three receivers to reorganize its affairs, occasioned no surprise in machinery supply circles, where the fact has been known for some time that the company's business was far from being in a satisfactory condition.

When the company was organized, in 1900, the bicycle craze had reached the summit of its prosperity. Bicycles had found their way into the humblest home in the land, and were utilized both for pleasurable and business purposes, especially the former. All of a sudden, the demand for them ceased, and for the past two years, and particularly for the past year, sales of bicycles have been diminishing. The reason for this is difficult to state. Considering the bicycle as a medium of pleasure, it can only be explained on the theory that in the matter of diversion the American people are rather fickle, as the retrograde tendency in rowing, cycling, pugilism, pool and billiard playing, etc., shows.

When the company saw its bicycle business declining it undertook the manufacture of automobiles. It expended large sums of money in putting a machine on the market that would meet with popular favor, but only with varying success. In the course of time its working capital, which never was of sufficient proportions, was seriously impaired, and recent developments followed as a natural consequence. The company attempted to introduce its products abroad, and opened an office in London with that object in view. Foreign sales were so unsatisfactory that the company closed this office not long afterwards.

In trade circles the future of the company is thought to largely depend upon whether or not bicycling will regain its former prestige, and whether or not automobiles can be manufactured to make them within reach of the masses, instead of the classes, as at present. Upon this point, as will be remembered, no less an authority than Thomas A. Edison has expressed himself in the affirmative.

Several conventions will be held next month which are certain to interest manufacturers of machinery. The most notable will be the first annual convention of the recently organized National Machine Tool Builders' Association. At this gathering there will be a "liberal discussion of subjects pertaining to the manufacture and sale of machine tools." In this connection it is interesting to note that the constitution of the association provides that at its annual conventions the association shall "make such laws, define such policy, adopt such resolutions and render such decisions as shall further the interests of the association, and the acts, resolutions and decisions of a national convention shall be final and binding upon all members." The date and place of the convention have not been set.

The convention of the Southern Supply and Machinery Dealers' Association will be held at the New Gayoso Hotel, Memphis, Tenn., on October 21, 22 and 23. C. B. Carter, of Knoxville, Tenn., the secretary-treasurer of the asociation, on behalf of its Board of Officers, extends a cordial invitation to all manufacturers to attend the convention.

The National Association of Agricultural Implement and Vehicle Manufacturers will be held at Minneapolis, Minn., on October 15, 16 and 17. A special invitation is extended to all vehicle and tool manufacturers, not members of the association, to be present.

In a petition to the Greater New York authorities, asking for the widening and closing of certain streets, President Newman, of the New York Central Railroad, promises that in the event of favorable action in the matter the company will substitute electricity for steam for all of its trains on the Hudson and Harlem divisions within the city limits, as far as Croton on the former and White Plains on the latter. Continuing, President Newman says: "The date upon which operation by electricity can be commenced will be determined, the necessary authority being obtained, upon the time required for the construction and equipment of power houses. It was with the desire of hastening and of prosecuting so much of this work as might be possible under the existing law that the negotiations were begun; and with the same desire the company is ready, if it has the co-operation of the city as prayed for in the petition, to enter into contracts for the power-houses required for operation by electricity just as soon as necessary details can be perfected."

Rumors have been current recently that financial difficulties have seriously interfered with the business of the United States Shipbuilding Company. After de-

claring that the reports are without foundation, Lewis Nixon says: "The company is formed and is doing business. What delay there had been was wholly incidental to making our combination perfect in every point. Every difficulty has been met and mastered. We are now facing the future with more brilliant prospects than we figured upon. Within the past few days we have secured orders for two new vessels and we are estimating on others."

Recent figures of the domestic exports for the seven months ending July, 1902, by way of comparison with a similar period for 1901, as given by the Bureau of Statistics, show declines in agricultural implements, cycles and parts, electrical and scientific apparatus, steel rails, structural iron and steel, metal-working machinery, electrical machinery, and locomotives. On the other hand, advances have been scored in steel wire, builders' hardware, pumps and pumping machinery, sewing machines, typewriting machines, miscellaneous machinery, and iron pipe and fittings. The detailed figures follow:

Articles.	1901.	1902.
Agricultural implem'ts.	$13,591,135	$13,318,258
Cycles and parts.....	1,861,891	1,845,265
Electrical and scientific apparatus.....	4,143,827	3,272,731
Steel rails.....	6,187,361	1,495,907
Struc'l iron and steel..	1,860,126	1,129,533
Steel wire.....	2,687,540	3,163,332
Builders' hardware....	5,221,353	6,460,330
Metal working mach..	1,751,548	1,682,661
Electrical machinery..	3,462,299	3,337,721
Pumps and pumping machinery	1,126,560	1,348,161
Sewing machines and parts.....	2,213,089	2,593,079
Locomotive engines....	2,639,967	1,182,509
Typewriting machines.	1,707,300	2,125,505
Miscellaneous mach'y.	10,352,786	12,621,363

The United Steel Company, Canton, O., have placed an order for four 250 water-tube boilers with the Pittsburgh Gage & Supply Company, Pittsburgh. Other recent contracts include power-transmitting machinery outfit for the Maryland Paper Company, and a rope transmission for the State Institution for Feeble Minded, Polk, Pa.

The Canadian Bridge Company, Walkerville, Can., are installing a second Northern three-motor electric traveling crane, 25 tons capacity, 60 feet span, manufactured by the Northern Engineering Works, of Detroit, Mich. This crane will be used to handle heavy girders in their yard.

The Burt Manufacturing Company, of Akron, Ohio, have just received the following orders: American Steel & Wire Works, two large Burt exhaust heads and a 200-gallon Cross oil filter for their works at Cleveland, Ohio, making the twenty-ninth order which they have received from this concern for oil filters; two Cross oil filters for use on one of the new torpedo boats, and also two filters for the navy yard at Bremerton, Wash.; the Detroit Copper Mining Company, of Morenci, Ariz., two fifty-gallon Cross oil filters, making ten of these filters now in use in their mines.

The bids for the new pumping plant at Baldwin's, L. I., will be opened by the Greater New York water authorities on September 11. The proposals have been advertised four times for various reasons, much to the annoyance of bidders, and at some expense to them.

The Stanley Rule & Level Company, of New Britain, Conn., are about to adopt electric driving throughout their works. They have recently purchased from the Westinghouse Electric & Manufacturing Company a 375-kilowatt 500-volt direct-current engine-type generator to be operated in connection with a marine-type engine running at 200 revolutions per minute furnished by Westinghouse, Church, Kerr & Co.

Pawling & Harnischfeger, Milwaukee, Wis., makers of electric traveling cranes and hoists, state that the booking of orders remains highly gratifying. Among orders recently received are the following: Minneapolis Steel & Machinery Company, Minneapolis, Minn., two 20-ton cranes with 5-ton auxiliary hoists, one 15-ton crane with 5-ton auxiliary hoist, one 5-ton crane; Crane Company, Chicago, one 2-ton crane; Wisconsin Bridge & Iron Company, North Milwaukee, one 10-ton crane; Baldwin Locomotive Works, Philadelphia, four 10-ton cranes; The Standard Steel Works, Burnham, Mifflin Co., Pa., two 10-ton cranes; Pennsylvania Lines West of Pittsburgh, Fort Wayne, Ind., one 10-ton crane; Moran Bros. Company, Seattle, Wash., one 5-ton hoist; Columbus Iron Works Company, Columbus, Ga., one 20-ton crane; Lalance & Grosjean Manufacturing Company, Harrisburg, Pa., one 15-ton crane; The Spang-Chalfant Company, Harrisburg, Pa., one 15-ton crane; the Ball Engine Company, Erie, Pa., three 3-ton hoist travelers; the Berlin Machine Works, Beloit, Wis., one 15-ton crane; the American Bridge Company, Economy, Pa., five 10-ton cranes, each with two 5-ton trolleys; the Ohio Farmers' Fertilizer Company, Columbus, Ohio, two 3-ton hoists; Betts Machine Company, Wilmington, Del., one 20-ton crane. The company recently acquired the Gardiner Campbell Company property adjoining their works. This property is 200x150 feet in size and the three-story building is being entirely remodeled to supply additional machine-shop facilities, also to provide extra pattern storage. The foundry is being changed over, and an addition made thereto, and in the entire building will be placed a modern foundry equipment. Among the improvements will be two P. & H. electric traveling cranes. The present power plant is being much enlarged and new boilers, engines and another generator will be provided. It is stated that these improvements will considerably shorten the time required to complete a crane or hoist.

CHICAGO MACHINERY MARKET.

A Chicago dealer in machinists' supplies stated that he had believed August to be a comparatively quiet month, but when the month's business was totaled he found it to vary only a few hundred dollars from that of August last year, which was the best August he had ever experienced. He added that some of the small machine shops had not been very busy during August, but that all the large ones were. The representative of an article used in every machine shop said his traveling salesmen in some parts of the West were complaining of a not very brisk business. A foundryman, who makes pulleys, hangers and similar products, said trade seemed to be quieting down a little. Of from twelve to fifteen representatives of manufacturers of machinists' supplies interviewed, the above were the only "minor notes" encountered.

The remainder of the interviews were strongly the opposite. One machinists' supplies seller said that if there was the usual increase of autumn trade over that of summer this year, a gain of some twenty per cent., it would put them all out of business, through inability to take care of it. The summer trade showed little, if any, decrease from that of the preceding months this year. Reports of sales this past summer being close to the top notch in the experience of the houses concerned were not uncommon. There is some difficulty in obtaining prompt shipment of some lines of goods. One house reports that screws, taps, dies and drills are all slow in getting from factory. Another says the difficulty with them is mainly the uncommon sizes, regular sizes and patterns coming forward with reasonable dispatch.

If there is to be any slackening of trade in the West this fall, as regards machine-shop purchases, it is not yet sufficiently developed to attract general attention. The preponderating mass of testimony favors a continuance of the unusual activity. Related industries have all the indices of undiminished activity. It is said that the only reason Chicago foundries are not melting 25 per cent. more iron than at this time last year is because they either cannot get the iron or are hopelessly short on coke. The business is before them, some foundries having sold their expected output well into the coming year.

The degree of activity in the country is perhaps relatively greater than in Chicago. It is based at least partially upon the fact that the farmers have more money to spend this year than ever before and are spending it. The machine-shop industry in the interior is growing steadily, but there, as well as in the cities, it is largely a building to old industries rather than the starting of new ones.

Quotations.

NEW YORK, Monday, September 8.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:

No. 1 X.....	$23 50 @ $25 00
No. 2 X.....	22 75 @ 23 50
No. 2 plain.....	22 25 @ 22 50

Southern:

No. 1 Foundry..... 22 00 @ 23 00
No. 2 Foundry..... 21 75 @ 22 50
No. 3 Foundry..... 21 25 @ 22 75
No. 4 Foundry..... 20 25 @ 21 25

Bar Iron—Base Sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base Sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel — Base sizes — From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11¾ @ 11⅞c.; electrolytic and casting, 11⅝ @ 11¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 27⅛ @ 27¼c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5⅝c.

Antimony—Cookson's, 10¼c.; Hallett's and U. S., 7¾ @ 8c.

Lard Oil—Prime City, 79 @ 81c., according to brand and quantity ranging from one barrel up to large lots.

New Catalogs.

Adam's Steel & Wire Works, Joliet, Ill. Woven wire and ornamental steel fencing. 6x9, pp. 49, paper.

Putnam Machine Company, Fitchburg, Mass. Lathes, planers, shapers, bolt cutters, etc. 6x9, pp. 161, paper.

New Corporations.

Truscott Manufacturing Co., Pontiac, Mich.; capital, $5,000; object, manufacturing a patent bench and step ladder, with other articles.

Manufacturers.

The New Fane Basket Company, Newfane, N. Y., is about to rebuild.

The American Peat Fuel Company is building a plant at Capac, Mich.

The Prairie du Chien (Wis.) Woolen Mill Company's plant has been partly destroyed by fire.

The Kingsland Paper Mills are about to build an addition to their plant at Nutley, N. J.

The capacity of the Pressed Steel Car Company's plant at McKees Rocks, Pa., will, it is said, be enlarged.

A new plant is to be built for the Union Petroleum Company, petroleum products, Philadelphia, Pa.

Plans have been made for a factory addition for the Michigan Chair Company, of Grand Rapids, Mich.

The Upson Nut Company, manufacturer of carriage hardware, Unionville, Conn., is building a new wire room.

The Sherwin-Williams Company, Chicago, paint manufacturer, plans to build a large new plant at Pullman.

The plant of the Easton (Md.) Furniture Manufacturing Company has been burned, but will probably be rebuilt.

E. T. Burrowes, Portland, Me., proposes to erect a 75x150-foot building for the manufacture of billiard tables.

The Fitzgibbons Boiler Company is negotiating for the removal of its factory to Waterloo, Ia., from Oswego, N. Y.

Butterfield & Co., manufacturers of taps and dies, Rock Island, Que., will erect a modern new factory, 100 feet long.

Joseph Black & Sons Company, hosiery manufacturers, York, Pa., will, it is believed, soon erect a building of its own.

Russell Jennings Manufacturing Company, manufacturer of augers and bits, is building a factory addition at Chester, Conn.

The Ada Manufacturing Company, yarns, of Charlotte, N. C., will issue $60,000 of preferred stock and install a number of looms.

The General Electric Company at Schenectady is about to erect a very large new machine shop. The dimensions are 800x135 feet.

Work is commencing on foundations for buildings of an open hearth steel plant of the Youngstown (O.) Iron Sheet & Tube Company.

Hartwell, Richardson & Kingston are the contractors to erect a manufactory for machinists' tools at 227 Eddy street, Providence, R. I.

The Ashland Emery & Corundum Company has leased land adjoining its factory at Perth Amboy, N. J., and will have a large plant there.

From a visit of officials of the Ohio Central Railroad to the car shops at Kenton, O., it is thought that the time may have come to enlarge them.

The National Cash Register Company will erect a branch factory in Canada. It is also said that a new factory will be built in Berlin, Germany.

J. H. White, who purchased the plant of the James Armstrong Soap Company, of Baltimore City, Md., thinks of moving it to Newport News, Va.

The plant to be erected for the F. S. Walton Company, oils, Philadelphia, Pa., will include a press-house, boiler- and engine-house, cooper shop, etc.

The Sterling Comb Company, of which Alexander S. Paton will be president, is to put up a 140x36-foot, three-story building at Leominster, Mass.

Ground has been broken at Cambridge, Mass., for a four-story, 200x124-foot building for W. L. Lockhart & Co., Boston, manufacturers of coffins and caskets.

The contract has been let for building a four-story, 80x50-foot addition to the factory of Comstock, Cheny & Co., manufacturers of ivory goods, Ivoryton, Conn.

Contracts have been awarded for an addition, 80x100 feet, to the factory of the Leland & Faulconer Manufacturing Company, Detroit, Mich., manufacturer of grinders, etc.

The Empire Metal Company, firm of Jacobus & Krulan, at 3 Peck Slip, New York, has dissolved partnership. Mr. Krulan is now proprietor of the Empire Metal Company.

A plant to cost $100,000 and employ 250 more men will be added to the Laidlaw-Dunn-Gordon works, at Elmwood, Cincinnati, O., of the International Steam Pump Company.

The Allis-Chalmers Company is discontinuing work at a plant in Buffalo which it has been running for some years, and is shipping the machinery to Milwaukee and Scranton.

An engineer from the General Electric Works, at Schenectady, N. Y., is said to have been visiting Cohoes recently to report the advisability of erecting a large power plant there.

The Globe Iron Works Company, Minneapolis, Minn., manufacturer of gas engines, has broken ground for a new foundry. The firm has just completed an addition to the main shop.

The West Coast Manufacturing & Investment Company, Ballard, Wash., is stated to be about to rebuild its burned shingle mill. It will also build a new sawmill to employ at least 100 men.

James Rees & Sons Company, boilermaker, Pittsburgh, Pa., is building an addition, 80x270 feet. In the addition will be placed machinery. A hydraulic riveting machine will be one of the features.

The additions being constructed at the plant of the Huber Manufacturing Company, Marion, O., manufacturer of farm engines, threshers, rakes and scrapers, will be twice the size first planned.

A three-story factory building, 75x400 feet, will be erected near Frankford Junction, Philadelphia, for A. J. Cameron & Co., worsted tops. The building will be equipped with an electric plant to furnish the power.

The American Insulated Wire & Cable Company, organized under the laws of New Jersey, has leased factory space in a building on Pacific street, Stamford, Conn., in which it intends to carry on manufacturing.

Putting up the steel frame of the new machine shop for the Farrel Foundry & Machine Company, Ansonia, Conn., is under way. The new building is wide enough to take in traveling cranes a little over 70 feet in length.

The Commercial Envelope Company, Binghamton, N. Y., will enlarge its plant by a building with 36,000 feet of floor space. A new corporation is being formed, to be known as the Commercial Envelope & Box Company.

The Sangamon Manufacturing Company is establishing a plant at Mildred, near Springfield, Ill., to make mining cars, tools and stoves. The main building is over 600 feet long and the smaller, which is to be used for a foundry, is 80 feet square.

The Mutual Machine Company, of Washington, N. C., has completed its machine shop and foundry and is ready for work. This shop is equipped with modern tools, and the company is prepared to execute work of all kinds, especially marine and mill work.

William L. Neufer, of the Neufer Cedar Company, of Whitehall, Mich., has been in Menominee looking over the ground for the establishment of another factory, for the manufacture of boxes, shingles and lumber. Nothing definite has been done in the matter.

The Pittsburgh Plate Glass Company is about to become a large paint manufacturer. It also will branch out into other lines and manufacture building supplies. The company is erecting at Newark, N. J., a paint plant which will have a capacity of 2,500 gallons a day. It owns also a plant in Milwaukee.

It is reported from Cincinnati, O., that the International Leather Company, recently incorporated for $5,000,000, has purchased the Nepper Oak Sole Leather Tannery, on Henry street, and will remodel it and put in new machinery. Three other plants will be put in operation in different parts of the country.

The Zimmerer Machine Company, builder of special machinery and tools (punches and dies a specialty), has opened its shop at 1558 Central avenue, Cincinnati, O. The firm consists of H. L. Cameron, for some years with the R. K. Le Blond Machine Tool Company, as foreman, and John Zimmerer, with experience as foreman and in the punch and die business.

It is currently reported that the Ingersoll-Sergeant Drill Company, whose main offices are in New York city, and whose plant is at Easton, Pa., has purchased a tract of 190 acres, beyond the limits of Phillipsburg, N. J., for new buildings. The company has been looking for a site for a long time and "Wolf" has been cried more than once as to its having fixed upon a location.

Charles T. Schoen has purchased 40 acres of ground at Butler, Pa., adjoining the plant of the Standard Steel Car Company, and will

begin the erection of a steel car wheel plant, to cost $500,000, and be enlarged later. The machinery, built by the Bethlehem Steel Company, is already set up in Bethlehem. The plant will manufacture its own steel, and will have a capacity of 400 wheels daily. Their tensile strength, it is said, will be 85,000 pounds. The wheels will be made by a continuous process.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Power press work, 247 W. Broadway, N. Y.

Will buy or pay royalty for good patented machine or tool. Box 282. AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

For Sale—One 24 in. x 24 in. x 6 ft. planer; been used 30 days. Box 860, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Machine for wax plate making wanted. Address Blue Island Specialty Co., Blue Island, Ill.

Book, "Dies and Diemaking." 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

Drafting, by the job or hour; contracts made for regular work; ideas perfected; all mechanical drawing done quickly and accurately. B. & K., care AMERICAN MACHINIST.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears, catalog of small tools free. R. M. Clough, Tolland, Ct.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

A Canadian firm with well-equipped machine shop for handling medium heavy machine work would like to enter into an agreement with some American machine firm to manufacture their goods for the Canadian market. Address Box 833, AMER. MACH.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R.; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Competent draftsman desires position; New York or vicinity. Box 849, AMER. MACH.

Experienced machine shop foreman open to receive offers; references. Box 861, AM. M.

Mechanical draftsman, quick tracer, wishes position as assistant. Box 841, AM. MACH.

Mechanical draftsman desires position; practical shop experience. Box 852, AM. M.

Wanted.—Draftsman with experience wishes position by electric company. Box 847, A. M.

For help, write The New York Engineering Agency, 35 Warren st., N. Y. No charge to employer.

Position by competent machine shop or toolroom foreman; A1 references. Box 835, AMERICAN MACHINIST.

By experienced machinist and engineer, capable of taking full charge of plant. Box 844, AMERICAN MACHINIST.

Situation as foreman, by thoroughly practical man; 12 years a foreman; jobbing, etc. Address Box 853, AMERICAN MACHINIST.

Wanted—Position as superintendent of plant or foreman of machine shop, by man of extended experience; references on request. Address C. E. Tower, South Bend, Ind.

Wanted—Position as foreman or operator of automatic screw machines; 12 years' experience; age 30; all references. Address "Automatic," care AMERICAN MACHINIST.

Wanted—Position as superintendent or foreman of iron foundry; practical and successful; accustomed to estimating, etc. Address R. H., care AMERICAN MACHINIST.

Technical graduate, with experience in power plants and as draftsman on engine work, desires to change; steam or general engineering preferred. Box 856, AMER. MACH.

Experienced machine designer, practical, thorough, original, 10 years on automatic machinery, graduate, wants position of responsibility in or out of drafting room. Box 817, AMERICAN MACHINIST.

Designer of special machinery, tools and fixtures for manufacturing purposes; man with technical education and 15 years' experience in this line seeks a position in Middle West. Box 846, AMERICAN MACHINIST.

Position as superintendent; experienced in handling large force of men on light interchangeable work, systematizing, cost reducing and card systems, designing of tools, jigs, dies, etc. Address Box 848, AMER. MACH.

A practical machinist of experience in the shop on different classes of work and tools and outside erecting work is open for an engagement and prefers outside erecting work; can furnish the best of reference as to character and ability. Box 855, AMER. MACH.

First-class mechanic, with 10 years' shop experience, 3 years chief engineer on sugar estate in tropics, also spent some time in drafting room, capable of looking after and taking care of machinery and handling men, wants position. Address F. W. B., care A. M.

A position as superintendent or assistant manager, by a young man, 32 years of age, of good executive ability and versed in systematizing and getting costs; can also do drafting, and versed with up-to-date methods; will start very reasonable. Address Box 845, AMERICAN MACHINIST.

Experienced draftsman, familiar with design of light and heavy special machinery, hydraulic tools and general shop work, desires a position in the vicinity of New York city; capable of taking charge of small drafting room; references furnished from present employer. Box 851, AMERICAN MACHINIST.

Managing engineer and commercial man, corporation business over million yearly, desires change; have excellent executive ability; wide experience; familiar with shop order systems and cost accounts; great head for following up detail; expert designer; a pusher; can keep peace among employees; correspondence solicited. Box 854, AMER. MACH.

Civil engineer wants position on railroad construction, as resident engineer, or with locating party in the field in Cuba, Mexico, Porto Rico or Philippine Islands; knows Spanish thoroughly; competent to handle native labor; 6 years' experience in Spanish-American countries; highest reference. Address, stating salary, location, etc., P. O. Box 1742, New York City.

Help Wanted.

For positions, send stamp to The New York Engineering Agency, 35 Warren st., N. Y., for registration blank.

Mechanical and structural draftsmen; experienced technical graduates preferred. Box 71, Station B, Cleveland, Ohio.

Wanted—Draftsman, experienced on punching and shearing machinery. Apply, stating age, salary. Box 796, AMER. MACHINIST.

Wanted—First-class diemakers to work on dies for sheet metal goods; steady work; state wages required. Address Box 828, A. M.

Foreman for machine shop; must be A1 man, accustomed to marine and mill work. Address Mutual Mchn. Co., Washington, N. C.

Machinists, send for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Young draftsmen wanted; state age, experience, wages expected, etc.; good opportunity. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

Wanted—Mechanical draftsman on machine tools; state age, experience and salary expected. Address Hilles & Jones Company, Wilmington, Delaware.

Wanted—First-class rivet maker who has had thorough experience on heading and axle machines; good wages. Address Box 842, AMERICAN MACHINIST.

Wood pattern maker for malleable and gray iron foundry in Western city; state age and experience and name of former employer. Box 843, AMERICAN MACHINIST.

Wanted—Six first-class machinists; state age, experience and wages expected; to work in shop within 20 miles of New York. Box 850, AMERICAN MACHINIST.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—Young man, about 30 years of age, practical mechanic with some ability as salesman, to travel as machine tool demonstrator. Box 822, AMERICAN MACHINIST.

Wanted—First-class mechanical draftsmen; cranes, steam shovels, etc. Reply, stating age, experience and salary required, to Bucyrus Company, South Milwaukee, Wisconsin.

Wanted—Foreman to take charge of tool and die room for sheet metal manufacturing concern; must be thoroughly experienced. Address, stating salary expected, Box 829, A. M.

Wanted—First-class machinists experienced on compressor or engine work; steady employment for good men. Chicago Pneumatic Tool Company, Franklin Air Compressor Works, Franklin, Pa.

Wanted—By a progressive firm in Buffalo, N. Y., a young mechanic, capable of assisting foreman in manufacturing parts for fine brass instruments; state age, experience and salary expected. L. C., care AMERICAN MACHINIST.

Estimator.—Wanted—A man capable of estimating weight and cost of machine work from drawings; one having knowledge of structural work preferred; give experience and salary expected. Address Box 799, A. M.

Wanted—Experienced mechanical draftsman, Vermont, for general machine shop; specialty, paper-making machinery and mill work; state age, education, experience, with whom, and salary required. Box 804, AM. M.

Wanted—A man thoroughly competent to harden tool steel die blocks from a few ounces to 200 lbs. in weight; must be thoroughly experienced and well recommended in every way. Apply to Box 826, AMER. MACHINIST.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—An all-around mechanic on Spencer, Hartford and Brown & Sharpe automatic screw machines; one who is capable of camming and making tools for same. Apply, giving age, experience and wages expected, Box 858, AMERICAN MACHINIST.

Wanted—Assistant superintendent in factory employing 400 men; must be familiar with shop practice and methods and capable of handling men; state age, experience, references and salary required. Address The Ohio Brass Company, Mansfield, Ohio.

Wanted—Experienced mechanical draftsman for position with a large manufacturing company located in Pennsylvania; applicants should state experience, age, salary expected and furnish reference; good position for the right man. Box 859, AMERICAN MACHINIST.

Wanted—An all-around machinist, to keep in repair the machinery of a manufacturing plant; must be able to make small tools, do ordinary pattern work, run lathe, planer and drill; a steady position for the right man; send references, stating how long employed and what wages received. Box 803, AM. M.

Wanted—A first-class draftsman and designer of experience, who has also had actual shop practice and is capable of acting as superintendent or assistant manager of a plant building automatic machinery and working about 85 men. Address, stating age, experience and salary wanted, to "N.," care AMERICAN MACHINIST.

Wanted—Engineer to plan and superintend the erection of additions to our manufacturing plant which we are making from time to time, the arrangement and erection of machinery, shafting, power plant, heating apparatus, etc.; permanent position; state age, experience, references and salary wanted. Address The Ohio Brass Company, Mansfield, O.

Wanted—Instructor in mechanical engineering to teach; machine shop, mechanical

drawing and either steam engineering laboratory, patternmaking or foundry practice; M. E. graduate preferred; good chance for advancement. Send qualifications and recommendations at once to Mechanical Engineering Department, Washington Agricultural College, Pullman, Wash.

Wanted—A man to act as Eastern representative for a concern building medium and heavy machine tools; must be a pusher and well acquainted with the Eastern trade; none need apply who are unable to furnish A1 references as to ability and character; New York will be headquarters; preference will be given a practical man with technical training. Address Box 857, AMERICAN MACHINIST.

State age, experience, by whom employed, etc.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

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Abrasive Materials

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Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Ball Bearings

See Roller Bearings.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Bearing Metal

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Philadelphia, Pa.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather
Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry. Co., Cleveland, O.

Blocks and Tackles
See Hoists, Hand.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers
Struthers, Wells & Co., Warren, Pa.

Books, Mechanical
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Wells Bros. Co., Greenfield, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Carborundum
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Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Motor
Graves Motor Mfg. Co., St. Paul, Minn.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Cloos, Jacob, Milwaukee, Wis.
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Smith Single Belt Reversing Countershaft Co., Melrose, Mass.
Wheaton Mach. Co., Boston, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Tower, A. B., Rockwell, Fla.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Toledo Machine & Tool Co., Toledo, O.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machine
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Troy File Works, Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Pattern Works, Chicago, Ill.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
French Mfg. Co., Kansas City, Kan.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathe Feed
Natonal Mach. Tool Co., Cin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fairbanks Mach. Tool Co., Springfield, O.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Gump & Co., A. W., Dayton, O.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Straley, Hasbrouck & Schloeder, New York.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Prentiss Tool & Supply Co., New York.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Engr. Wks., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Toledo Mach. & Tool Co., Toledo, Ohio.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Gump & Co., A. W., Dayton, O.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reade & Co., Wm. A., Cleveland, Ohio.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Boston, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.
Toledo Machine & Tool Co., Toledo, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Machinery
Hermann Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Hermann Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Special Machinery Co., Bridgeport, Conn.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Counterbalances for Locomotive Cranes.

BY ROBT. H. KIRK.

The five factors which determine the weight of a locomotive crane are as follows: 1. Gage of track. 2. Working load at maximum radius. 3. Load at maximum radius required to tip crane over. 4. Minimum weight required for machinery, boiler, truck and framework. (This should include everything except counterweight.) 5. Position of the center of gravity of parts mentioned under 4.

For cranes where the capacity and radius are small, or where the gage of the track is large, it is sometimes possible that the minimum weight as mentioned under article 4 will be sufficient to satisfy the conditions of stability and no counterweight will be required. In general, however, the position of the center of gravity of such a machine will not be favorably located and the addition of counterweights would increase the capacity without materially increasing the cost. Wear and tear on the track and cost of manufacture are both conditions which are satisfied only by the lightest machine possible, consistent with the work which it has to perform.

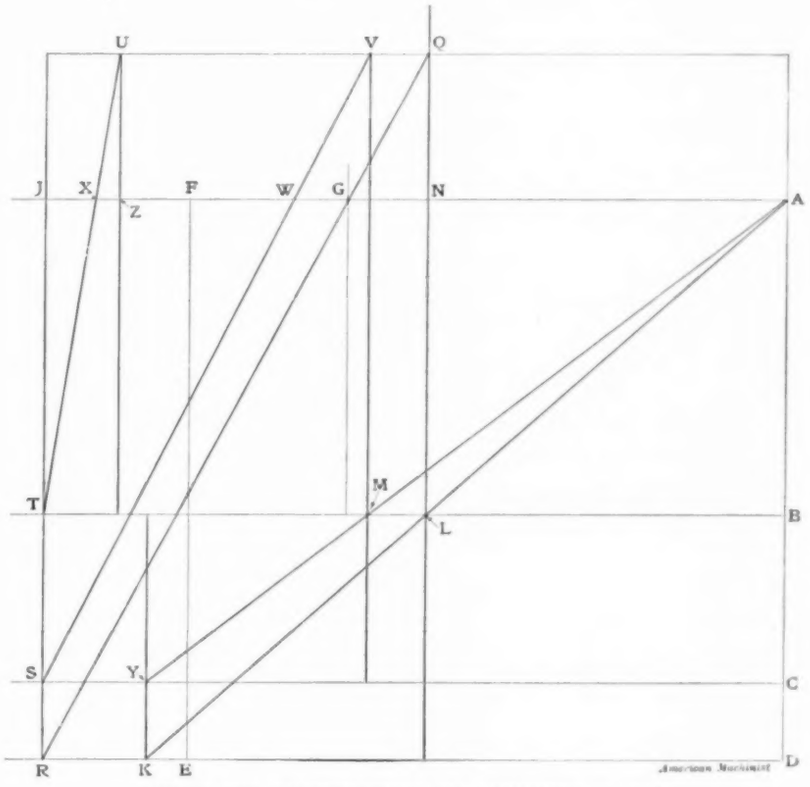
The conditions of minimum weight are attained when the machine is as liable to tip over forward when carrying the working load, as it is to tip backward with no load and the boom at minimum radius. Or, in other words, with the boom perpendicular to the track, the center of gravity of the machine with working load on, must be as near to one rail as it is near the other rail when the load is removed and the boom raised to its highest position. In passing from one condition to the other the center of gravity travels equal distances on either side of the vertical pivot of the crane. The precise distance through which the center of gravity travels is usually not considered, but it is determined indirectly by assuming the load which would be required to tip the crane over with the boom at its maximum radius.

The problem as usually presented is as follows: Given a certain set of castings, boiler, truck, framework, etc., to produce a crane of a certain capacity, radius and gage of track.

The first thing to do is to determine the weight of the complete machine, including water in the boiler, but omitting counterweight. This is easily accomplished if a track scale can be used, but if not the individual parts can be weighed separately and added together. Second, find the position of the center of gravity of the machine with the boom at the maximum and also at the minimum radius. This may be done by weighing the loads on the front and back wheels separately, and computing the position of the resultant of the two forces. Another way is to load the crane until the wheels just begin to leave the track and, knowing the load and weight of the crane, compute by moments the position of the center of gravity. The most tedious and least accurate way is to determine the weight and center of gravity of each piece separately and combine them to give the desired result. This last method is unsatisfactory, as parts may be omitted and the amount of work is so great that errors are liable to creep in even when great care is exercised.

Having determined the weight and center of gravity by the most convenient method, the quantity of counterweight and its position might be determined analytically to satisfy the conditions of minimum weight as enumerated above. The analytical solution, however, is long and the following graphical method will be found more convenient and sufficiently accurate:

Referring to the illustration, draw two lines $A\,D$ and $A\,J$ at right angles; lay off $A\,B$ = weight of crane (including water in boiler, but omitting counterweight); lay off $B\,C$ = working load at maximum radius; lay off $B\,D$ = tipping load at maximum radius. Through B, C and D draw lines parallel to $A\,J$; lay off $D\,E$ = maximum radius of cranes. Draw $E\,F$ parallel to $A\,D$; lay off $F\,G = \frac{1}{2}$ gage of track; lay off $E\,K$ = distance of center of gravity of crane back of vertical pivot with boom at maximum radius; lay off $F\,Z$ = same as $E\,K$ with boom at maximum radius. Draw $K\,Y$ and $Z\,U$ parallel to $A\,D$; draw $K\,A$ and $Y\,A$. The intersection L locates the position of the center of gravity of crane and tipping load, and the intersection M locates the position of the center of gravity of the crane and working load. Through M, L and Z draw lines parallel to $A\,D$.



FINDING THE COUNTERWEIGHT FOR LOCOMOTIVE CRANES.

Assume a possible value for the counterweight and lay off of $N\,Q$ equal to this value. Through Q and G draw a line interesecting $D\,E$ at R. Draw through R a parallel to $A\,D$, draw through Q a parallel to $A\,J$. Connect T with U and S with V. The point of intersection W locates the center of gravity of the crane with its working load at maximum radius and the assumed counterweight. The point of intersection X locates the center of gravity of the crane without any load, with its boom at minimum radius and the assumed counterweight.

To fulfill the condition of minimum weight these points must be equidistant from the vertical pivot F, or $W\,F = F\,X$. If $X\,F$ is greater than $F\,W$, the value assumed for counterweight was too small, and if $X\,F$ is smaller than $F\,W$, the value was too large.

Assume another value for the counterweight and repeat the construction from that point. As a rule, not over three trials will be sufficient, and as the work is direct only a short time will be required.

Having satisfied the condition that $F\,W = F\,X$, the counterweight will be the value assumed, and its distance back of the vertical pivot will be $= R\,E$. The counterweight may be placed partly in the truck and partly in the frame of the machine, to suit the conditions; its center of gravity however must at all times be at distance $R\,E$ from the vertical pivot.

In the description it has been assumed that the radius of the crane is variable, but the construction applies equally well

to a fixed radius, in which case $KE = FZ$. The work has been carried on using the load at maximum radius, for from these results the load at any other radius may be found proportioned to the radius minus one-half the gage of the track. Had the mean radius been used instead of the maximum it would have been necessary to consider the weight of the boom in calculating the capacity of greater radii. In calculating from a greater to a less radius the weight of the boom need not be considered, as its movement toward the pivot will increase the stability and the capacity will be slightly in excess of the calculations.

Elevator Safety Governors.

BY WM. BAXTER, JR.

In the several articles describing elevator safety appliances which were published in previous issues of this journal, a safety governor was shown that is similar in design to those commonly used on steam engines. This type of governor is mounted on top of the overhead framing that supports the sheaves over which the lifting ropes run, and it is driven by an endless rope that is attached to the elevator car and therefore moves at the same velocity. Safety governors are also made so as to be mounted directly upon the elevator car, generally on top of it, and these are driven by a stationary rope which is secured to the top and bottom of the elevator well. A governor of this kind is shown in Figs. 1 and 2, arranged to actuate a safety of the roller type. The governor proper is shown at N and consists of a casing having a grooved wheel formed at its edge, and a weighted lever within the casing which is held against the center hub by the tension of a spring, and is forced outward by centrifugal force, in the same manner as the flywheel governors used on engines.

The side lifting rods FF that raise the rollers into the active position are held by the levers E mounted upon the rock

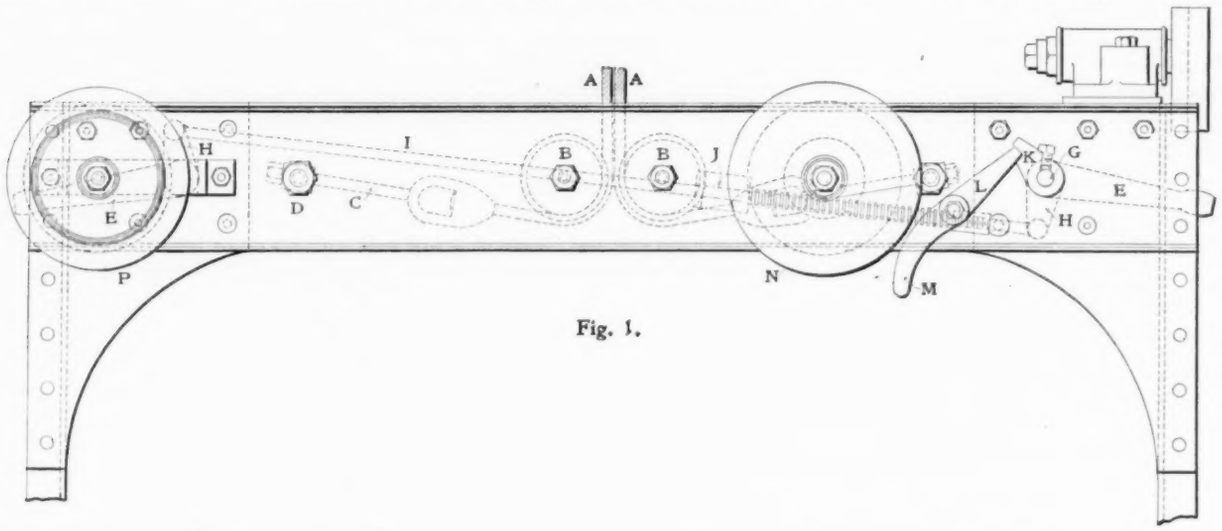


Fig. 1.

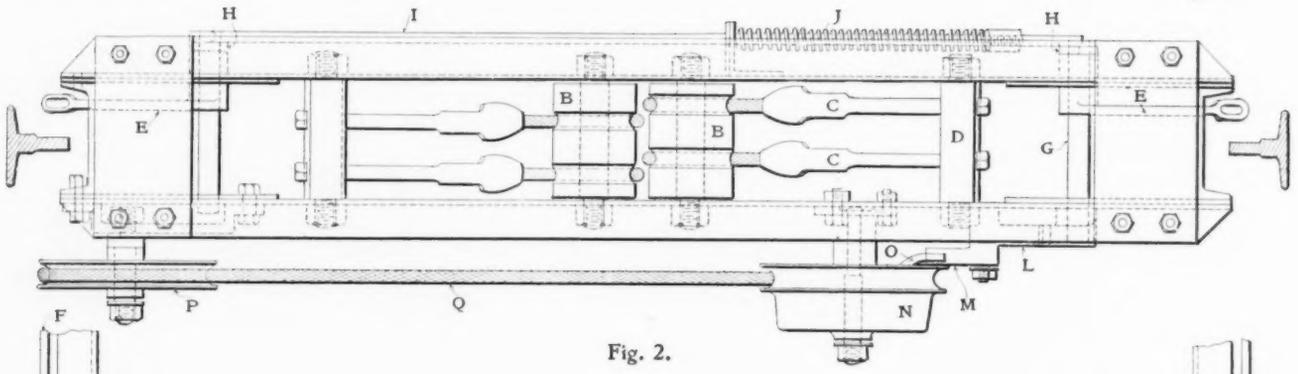


Fig. 2.

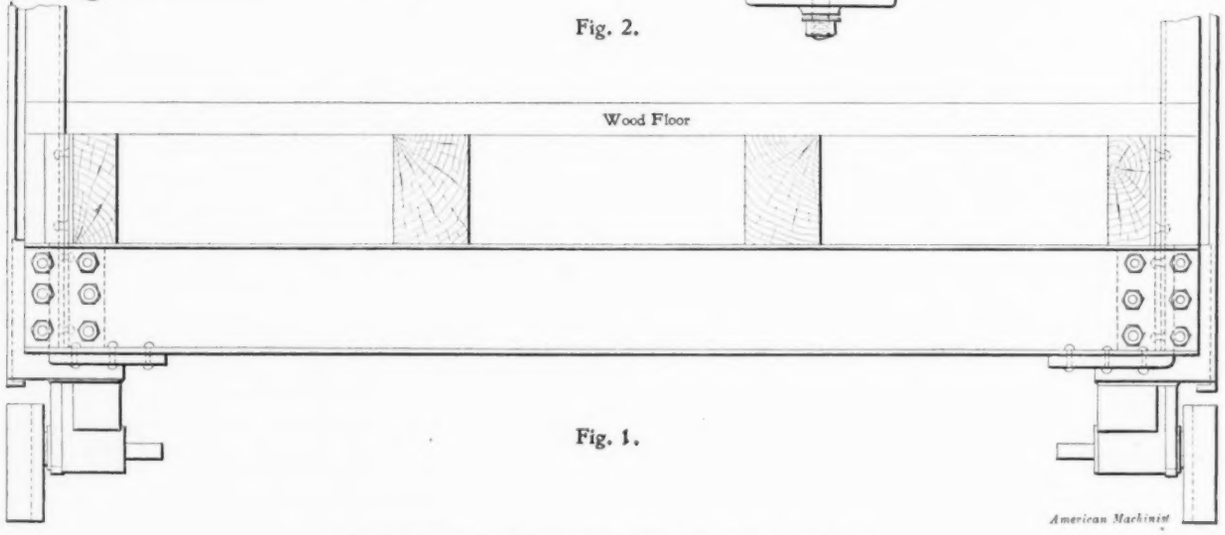


Fig. 1.

ARRANGEMENT OF GOVERNOR ATTACHED TO ELEVATOR CAR.

shafts *G*. The two rock shafts *G* at either side of the car are connected with each other through the levers *H H* and connecting rod *I*, the spring *J* acting to move *I* toward the right and thus to lift levers *E E*. On one of the *G* shafts a short lever *K* is provided which engages with the upper end *L* of a cam lever that is actuated by the governor.

The governor is driven by the rope *Q* which passes over the sheave *P* located at the left side of the car and under the governor *N*. The end of the rope passing up from the right side of the governor goes to the top of the elevator well, where it is secured to the overhead framing. The other end which passes down from the left side of sheave *P* runs to the bottom of the elevator well, where it is secured so as to be at all times under proper tension to prevent slipping around governor, and also to have a sufficient vertical movement to compensate for expansion, but it cannot be displaced laterally. The sheave *P* is placed so as to lead the rope down in the space between the side of the car and the elevator well, but the governor *N* can be located at any point where the construction of the other parts of the apparatus may require, as there is nothing to interfere with the position in the elevator well of the governor rope above the car.

As the rope *Q* is stationary, it can be seen that the faster the car moves the faster the governor will revolve; hence, by setting the latter so as to act at any given speed, the safety can be made to go into action when the car velocity is such as will develop this speed. In Fig. 2, it will be seen that an arm *O* projects from the back of the governor and is in line with the end *M* of the lever that holds *K* in the inactive position. This arm *O* is attached to the governor weight and swings out from the center with the weight. When the velocity of the governor becomes sufficiently great the arm *O* swings out far enough to strike *M* and knock the end *L* of this lever out of engagement with *K*. As soon as this occurs, the spring *J* forces rod *I* and levers *H H* to the right and thus the side rods *F F* are lifted and the safety rollers are thrown into action. It can be seen readily that as *O* moves out from the center gradually, the first time it strikes *M* it will not move it far enough to allow *K* to drop, but at each succeeding revolution *O* will swing further from the center because whenever it moves out far enough to strike *M* it is because the car has attained a velocity exceeding the normal, and this velocity is constantly increasing, so that the governor speed is constantly increasing, and on that account at each revolution *O* swings further from the center. From this it follows that the first blow struck on *M* by *O* will generally only move *L* a portion of the distance required to free it from *K*. The second blow in all probability will move *L* the balance of the distance. If the rock shafts *G*, the ends of *L* and *K* or the stud that carries *L* should be stuck fast by reason of neglect to keep them in proper condition the arm *O* will strike blow after blow on *M*, each blow with greater force than the previous one, and unless the parts adhere to each other with far greater tenacity than is at all likely to be the case *K* will eventually be released and the safety will go into action. This principle of releasing *K* by striking successive blows is a very good one because the jar produced by the blows acts to shake loose all the joints and thus insure their movement as soon as *L* is moved out of the way.

The way in which this governor is shown in Figs. 3, 4 and 5, the first being a horizontal section through the center of Fig. 4, which latter figure is a section on the line *A B* in Fig. 3. Fig. 5 is a vertical section through Fig. 4 on the center line. As is shown in these drawings, the arm *O* is an extension of the weight *F* which swings around the stud *G* and is pressed against the hub *D* of the governor casing by the tension of spring *L* acting against the end *H*. The caps *J J* hold the spring in position between the adjusting screw *K* and the point on end *H* of the movable weight. The governor revolves around the stationary stud *E* which is secured to the side of the car cross-head by means of the flange *M*, washer *P* and the nuts

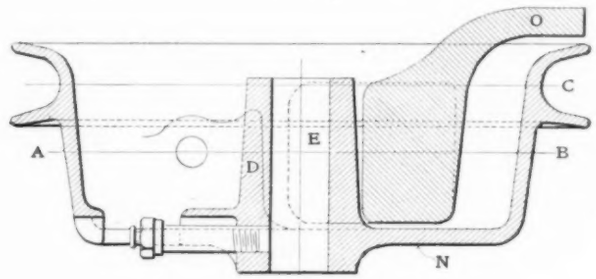


Fig. 3.

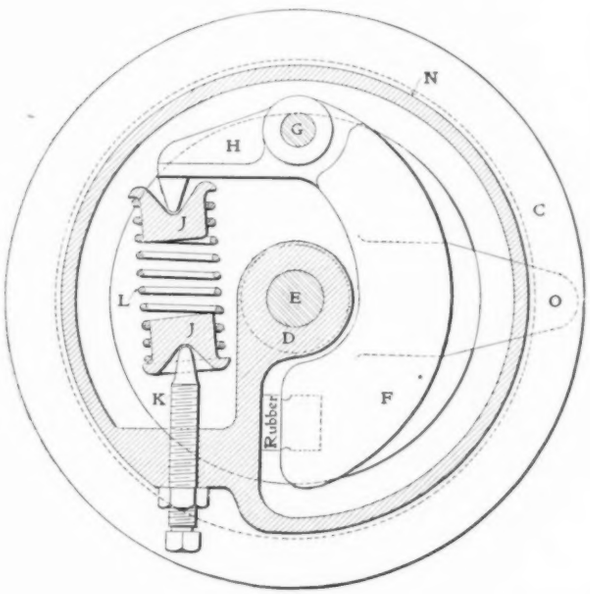


Fig. 4.

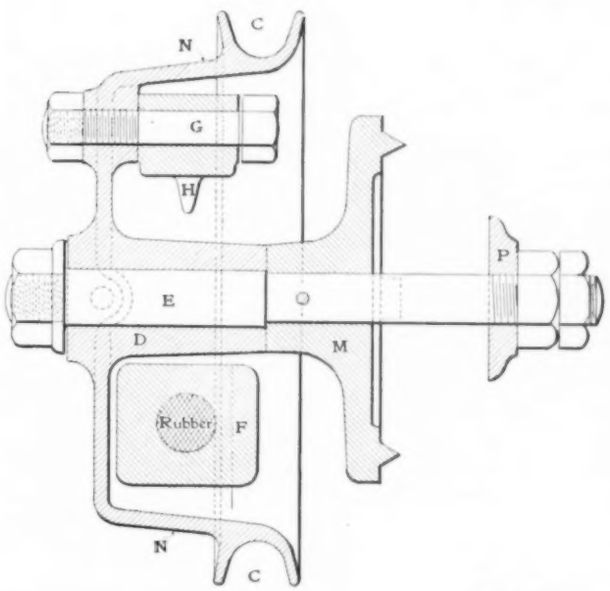


Fig. 5.

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CONSTRUCTION OF GOVERNOR SHOWN IN FIGS. 1 AND 2.

shown. The driving rope runs in the groove *C*.

This type of safety governor can be used with the wedge, the roller and the triple grip safety, but not with the clamp safety, because for the latter the action must be such that the rope that rotates the safety drum will continue to unwind until the car comes to a stop, and this result cannot be obtained with this governor, which only acts to trip a catch that holds the safety actuating levers in the inactive position.

Figs. 6 and 7 show a stationary governor made upon the same principle as the one just described, with the exception that it has two weights and is therefore balanced. On the circle to catch the projection *E*, Fig. 7, and throw the brake shoe *F* up against the groove *G*. The stops *T T* act as abutments against which *A A* are held so as to not be forced beyond a certain distance from the center, either by centrifugal force or by striking against *E*. The weight *H*, on the end of arm *I*, acts to hold *F* up against the wheel after it has been thrown into action by the arms *A A*. As shown in Fig. 7, the arm *I* and the projection *E* are both cast in one piece with trunnions *R R* that rock in the depressions formed in the frame *Q* by the projections *S S*.

This type of governor is driven by a hemp rope, and is used in connection with

The way in which this type of governor is connected with the elevator car for actuating the roller and triple grip safeties is shown in Figs. 8 and 9. The first figure shows the connection for operating the roller safety, and the second is for the triple grip device. In one case both ends of the governor rope are fastened to the safety lever, but in the other one end is made fast to a rigid support on the car frame and the other end is connected with the safety lever. This latter connection is not so likely to throw the safety into action by any sudden movement, as a portion of the strain developed by the resistance to motion of the governor and the lower sheave is taken by the stationary support

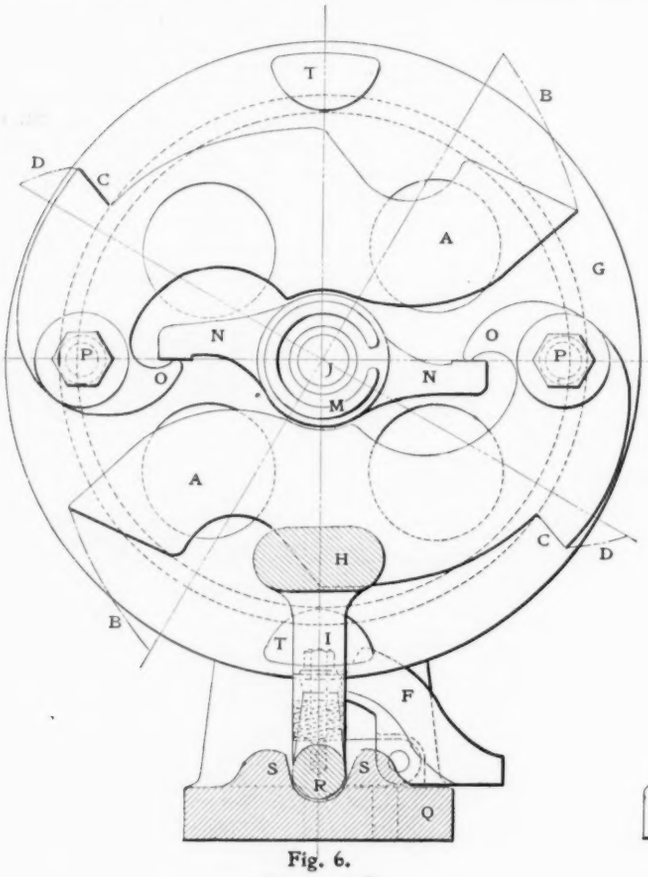

Fig. 6.
Section A-B.

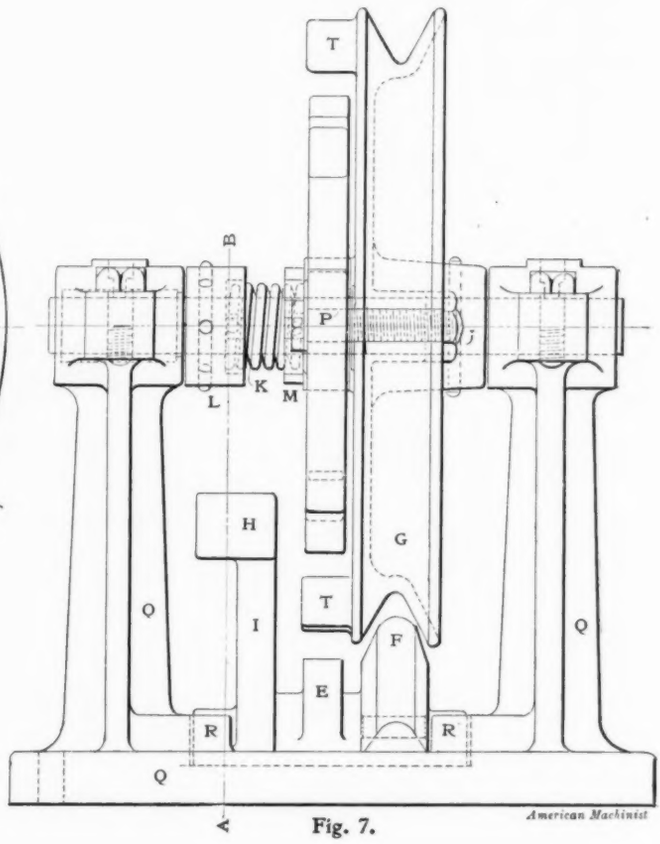

Fig. 7.

BALANCED GOVERNOR.

As shown in Fig. 6, the governor consists of a wheel mounted upon a shaft *J* and carrying two weighted arms *A A* pivoted at *P P*. The short ends *O*, of these arms, press against the ends *N* of a piece *M*, which is held in position by means of the spring *K*, shown in Fig. 10. The torsional resistance of this spring acts to hold *M* in position, and the centrifugal force of the arms *A A* acts to move it out of position. By twisting *L* around the shaft *J* the force of the spring can be adjusted so as to permit the arms *A A* to swing out at any velocity desired. When the arms swing out, the extreme ends follow the curves *B* and the projections *C* follow the curves *D*, thus providing four points

the wedge, the roller and the triple grip safeties, but not with the clamp brake safety. It cannot be used with the latter because the driving rope is held by the friction against the groove *G*, and while this can be made sufficient to hold the rope under ordinary conditions by properly shaping the groove it is not reliable enough to be depended upon. The governor can be used in connection with a clamp safety by setting it in the inverted position, so that the brake shoe *F* will wedge the rope against the bottom of the groove in the wheel. In that case a spring, as is shown in broken lines in Fig. 9, is provided to hold *F* in position against the rope, and the weight *H* is removed.

or dead hitch, as it is called. Owing to this fact the device can be made more sensitive in its action than when the connection is as in Fig. 8.

Interesting Facts from the Patent Office.

We have received a bulletin of the twelfth census, entitled "Patents in Relation to Manufactures," from which we make the following interesting extracts. It is well known that ours was the first patent office to make searching examinations of patent papers and to limit claims of novelty to such points as the examination appeared to justify. It was formerly the practice of all countries to throw the burden of defining his claims on the inventor and to

depend on subsequent action in the courts to determine whether or no the claims in the patent were justified by the "state of the art" when the patent was issued. Of course everybody knows that many fool patents and absurd claims get past this examination, but no one who has ever patented an invention can doubt that the examination does cut down the breadth of vast numbers of claims and thus make the patents on record a reasonably accurate statement of the state of the art with which subsequent inventors may, with reasonable assurance, adjust themselves. It may be compared to a coarse mesh screen which does not perform its functions perfectly,

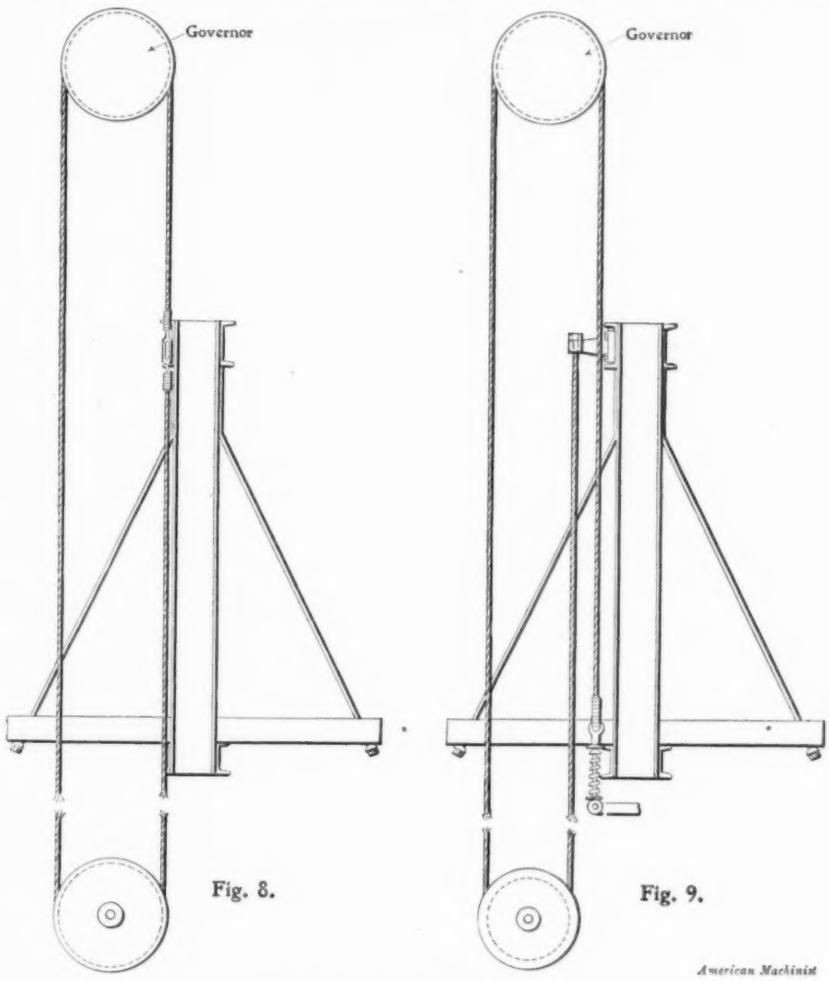

Fig. 8. Fig. 9.

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ATTACHMENT OF GOVERNOR TO CAR.

but the effect of whose work is nevertheless all in the right direction. This feature of our practice has been widely copied abroad, as we learn from the following extract from the bulletin in question:

"The demonstration of the effect of beneficent patent laws has led to their modification in all the chief industrial countries, and the salient feature of our system—a preliminary examination as to novelty and patentability prior to the grant of a patent—has in late years been incorporated into the patent systems of many foreign countries, as, for instance, Austria, Canada, Denmark, Germany, Japan, Norway, Russia, Sweden and Switzerland."

The following item regarding the first and last patent issued during the first century of American patents is of interest:

"The first patent granted by the General Government was to Samuel Hopkins, July 31, 1790, for an improvement in pot and pearl ash manufacture. The last patent granted for the year 1889, at the close of the first hundred years of patent issues, was to Wilhelm Dreyer, No. 418,664, of December 31, 1889, for an electro-magnetic typesetting machine. These two patents are suggestively symbolical of the progress of the century in invention and manufactures—the first akin to the primitive industries of a new country and the last serving the exacting demands of a highly organized industrial system.

"The total number of patents issued during this century of invention was 428,621."

The patenting of inventions by foreigners is a larger factor in the work of the office than we had supposed. Thus we find that for the decade ending 1900 the proportion of the total number of patents issued to aliens was 10.25 per cent.

"The growth in the number of patents granted in the United States to citizens of foreign countries is a striking feature, and shows the high esteem in which this country is held by the world at large as a field for the exploitation of inventions. Since 1860 the number of patents issued to citizens of foreign countries has increased in a much greater ratio than the number of patents to citizens of this country. For the decade of 1870 the increase in number of patents to citizens of the United States over the preceding decade was 257.63 per cent., while for foreigners it was 523.22 per cent.; for the decade of 1880 the increase to citizens of the United States was 74.52 per cent., and to foreigners 208.39 per cent.; for the decade of 1890 the increase to citizens of the United States was 50.09 per cent. and to foreigners 126.62 per cent.; and for the decade of 1900 for citizens of the United States the growth was 11.05 per cent., while for foreigners it was 70.96 per cent."

. . . . . .

"This marked growth in the number of patents to aliens is explained by the very liberal features of our patent system. Foreigners stand here on an equal footing with citizens of this country, and they are neither subjected to restrictions in the matter of annuities or taxes payable after the grant of a patent, nor required to work an invention in this country to maintain it in force, as is the case in most foreign countries.

"Moreover, the thorough examination made by our Patent Office . . . and the care exercised in criticizing the framing of the claims has come to be recognized as of great value in the case of inventions of merit, and hence the majority of foreign inventors patenting in this country take advantage of this feature of our patent system, and secure the action of the Patent Office on an application for a patent before perfecting their patents in their own and other foreign countries, taking due precaution to have their patents in the different countries so issued as to secure the maximum term in each, so far as possible. This practice holds now in the case of probably nine-tenths of the alien inventions patented in this country.

. . . . . .

"This phase of our patent system calls for serious consideration. The great chemical houses of Germany with their highly trained chemists working along special lines, and with the manufacture of new compounds fostered by the requirement that an invention must be worked in Germany to an adequate extent within three years after being patented, have held their patents in this country to protect their market, with the result that at the expiration of the patent term the trade is in the hands of the foreign manufacturers, and the equipment, trained workmen and chemists are all abroad contributing to the building up of foreign manufactures, instead of aiding in our own development."

We had hoped to find something in reference to the imposition of a small fee at

stated periods of a patent's life, but fail to do so. Many inventors find old patents in their way which are practically abandoned and dead, but which spring into life with certainty when later inventions make them practicable. The older invention will not work and the patent for it has no value until a later inventor supplies the keystone of the arch, but the later inventor is, under present practice, absolutely at the mercy of the former one. We believe that a series of fees to be collected at stated intervals and on which the continued validity of the patent would depend, would, by clearing away the old lumber which is of no value to anyone, be of immense value to the industries of the country and at the same time work hardship to no one. Of course, there is the difficulty that good patents might lapse by neglect or oversight, but some feasible plan of giving notice to the patentee might, we think, be devised. This is a feature of the patent laws of many countries, and we are not aware that anyone has found it to work injustice. Of its desirability there can be no question.

Electrical Tests of Power Required for Drilling Cast Iron from the Solid.

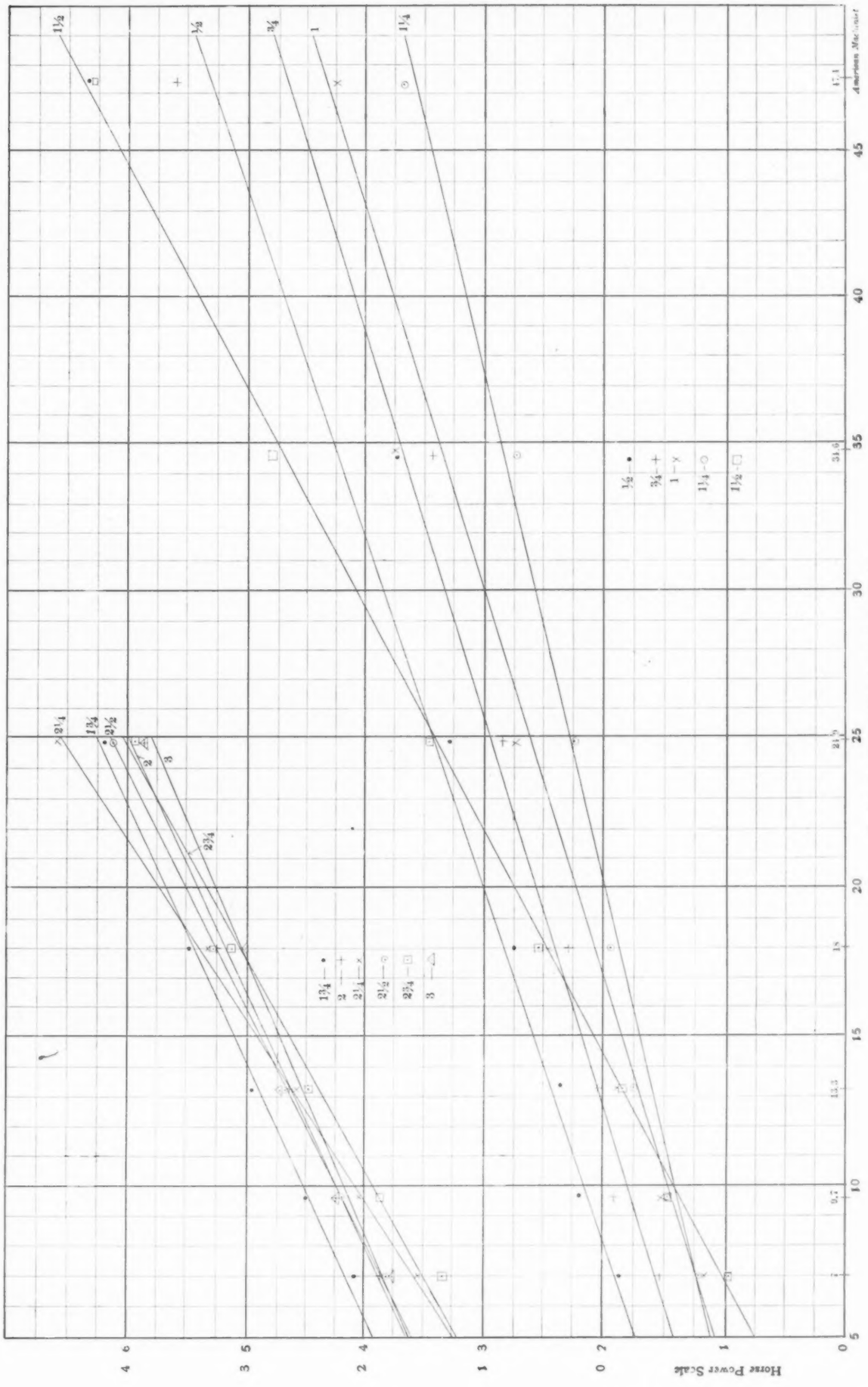
In connection with electrical driving the Bickford Drill and Tool Company have felt the need of more accurate data than were available for the power required for operating drilling machines with different sizes of drills. They therefore instituted a series of tests which are much more complete than any others with which we are acquainted and, with great liberality, they have given us a copy of the data for publication.

The accompanying table gives the tests complete. They will be seen to cover drills from ½ to 3 inches diameter under feeds of from .007 to .0474 inch per revolution, up to the 1½-inch drill, and from .007 to .0249 beyond that size. The tests were equally as thorough in other respects. The electrical testing instruments were supplied by the Triumph Electric Company and the readings were taken by an expert from the same company. The motor used was a constant speed machine and since the figures for the horse-power were taken from the current readings they include the power required to drive the motor as well as the motor losses. Readings were taken at each speed with the drilling machine running light as well as at work and the differences are given in one of the columns of the table as the power consumed by the work. Of course, this is not an entirely satisfactory method, as the machine undoubtedly absorbs more power when under load than when running light, but it is the best that can be done without elaborate dynamometer tests, the value of which would scarcely be justified if made, as, after all, it is the power required to drive the machine when at work that is wanted.

The tests were made on one of the latest improved No. 1 Bickford "New Radial" machines. Consulting the table, the first thing that strikes one is the sudden increase in the power required to drive the machine with the 1¾-inch drill. The power required to drive the machine will be seen to progressively decrease as the

No. of Test.	Diameter of Drill.	Feed per Revolution.	Revolutions per Minute.	No. of Cu. Inches Removed per Minute.	Horse-power Consumed.			Horse-power Consumed per Cubic In.	
					By Machine.	By Work.	Total.	By Work.	Total.
1	½″	.0070	299	.411	1.23	.65	1.88	1.58	4.58
2	"	.0097	"	.569	1.28	.93	2.21	1.63	3.88
3	"	.0133	"	.781	1.39	.88	2.27	1.13	2.90
4	"	.0180	"	1.06	"	1.36	2.75	1.28	2.59
5	"	.0249	"	1.46	"	1.91	3.30	1.31	2.26
6	"	.0346	"	2.03	"	2.36	3.75	1.16	1.85
7	"	.0474	"	2.78	"	5.00	6.39	1.80	2.28
8	¾″	.0070	206.5	.638	.72	.83	1.55	1.30	2.43
9	"	.0097	"	.885	"	1.19	1.91	1.34	2.16
10	"	.0133	"	1 21	"	1.34	2.06	1.11	1.70
11	"	.0180	"	1.64	"	1.58	2.30	.96	1.40
12	"	.0249	"	2.27	"	2.15	2.87	.947	1.26
13	"	.0346	"	3.16	"	2.85	3.57	.902	1.13
14	"	.0474	"	4.36	"	4.91	5.63	1.13	1.29
15	1″	.0070	143	.786	.46	.70	1.16	.891	1.48
16	"	.0097	"	1.09	"	1.06	1.52	.972	1.39
17	"	.0133	"	1.50	"	1.42	1.88	.946	1.25
18	"	.0180	"	2.02	"	2.02	2.48	1.00	1.23
19	"	.0249	"	2.80	"	2.27	2.73	.811	.976
20	"	.0346	"	3.89	"	3.29	3.75	.846	.965
21	"	.0474	"	5.32	"	3.81	4.27	.716	.803
22	1¼″	.0070	99	.852	.31	.87	1.18	1.02	1.39
23	"	.0097	"	1.18	"	1.18	1.49	1.00	1.26
24	"	.0133	"	1.61	"	1.44	1.75	.888	1.08
25	"	.0180	"	2.18	"	1.64	1.95	.752	.894
26	"	.0249	"	3.02	"	1.93	2.24	.638	.742
27	"	.0346	"	4.20	"	2.42	2.73	.576	.650
28	"	.0474	"	5.75	"	3.38	3.69	.588	.642
29	1½″	.0070	82	1.01	.24	.74	.98	.725	.960
30	"	.0097	"	1.40	"	1.25	1.49	.892	1.06
31	"	.0133	"	1.92	"	1.61	1.85	.838	.963
32	"	.0180	"	2.60	"	2.33	2.57	.896	.988
33	"	.0249	"	3.59	"	3.24	3.48	.902	.970
34	"	.0346	"	5.00	"	4.57	4.81	.914	.961
35	"	.0474	"	6.84	"	6.11	6.35	.893	.928
36	1¾″	.0070	68.5	1.15	.80	1.37	2.17	1.19	1.89
37	"	.0097	"	1.60	"	1.69	2.49	1.06	1.56
38	"	.0133	"	2.19	"	2.14	2.94	.978	1.34
39	"	.0180	"	2.96	"	2.68	3.48	.910	1.18
40	"	.0249	"	4 10	"	3.39	4.19	.826	1.02
41	2″	.0070	57	1.25	.57	1.31	1.88	1.050	1.50
42	"	.0097	"	1.73	"	1.67	2.24	.966	1.30
43	"	.0133	"	2.38	"	2.04	2.61	.894	1.10
44	"	.0180	"	3.22	"	2.65	3.22	.824	1.00
45	"	.0249	"	4.46	"	3.31	3.88	.742	.870
46	2¼″	.0070	47.2	1.31	.30	1.22	1.52	.931	1.16
47	"	.0097	"	1.82	"	1.73	2.03	.951	1.11
48	"	.0133	"	2.49	"	2.26	2.56	.908	1.03
49	"	.0180	"	3.37	"	3.01	3.31	.893	.982
50	"	.0249	"	4.67	"	4.28	4.58	.916	.980
51	2½″	.0070	39.3	1.35	.30	1.55	1.85	1.15	1.37
52	"	.0097	"	1.87	"	1.90	2.20	1.01	1.18
53	"	.0133	"	2.56	"	2.33	2.63	.910	1.03
54	"	.0180	"	3.47	"	2.95	3.25	.850	.936
55	"	.0249	"	4.80	"	3.81	4.11	.794	.856
56	2¾″	.0070	32.6	1.35	.28	1.06	1.34	.786	.992
57	"	.0097	"	1.88	"	1.57	1.85	.835	.984
58	"	.0133	"	2.57	"	2.17	2.45	.844	.954
59	"	.0180	"	3.48	"	2.83	3.11	.813	.894
60	"	.0249	"	4.82	"	3.65	3.93	.757	.816
61	3″	.0070	27	1.34	.35	1.43	1.78	1.07	1.33
62	"	.0097	"	1.85	"	1.89	2.24	1.02	1.21
63	"	.0133	"	2.54	"	2.34	2.69	.922	1.06
64	"	.0180	"	3.43	"	2.66	3.01	.775	.877
65	"	.0249	"	4.75	"	3.53	3.88	.728	.800

ELECTRICAL TESTS OF POWER REQUIRED FOR DRILLING CAST IRON FROM THE SOLID.



RELATION OF POWER, FEED AND SIZE OF DRILL IN DRILLING CAST IRON FROM THE SOLID.

speed is reduced up to this point when it jumps up, to again resume its downward course, with, however, an increase at the end. The cause of this is unknown. There is a change in the driving gear train at this point by which the load is carried through an additional gear, and our suggestion was that the increase in power shown was due to this. Mr. Norris, however, considers this explanation insufficient, his idea being that the cause of the action must be looked for in the drill itself, which may have been of inferior steel or improperly tempered. Relatively speaking, the matter is not of large importance as a factor in the column of total horse-power consumed.

The two right-hand columns give the horse-power required per cubic inch of metal removed per minute, the next to the last column being calculated from the power consumed by the work and the last column from the total power consumed. While the figures of the next to the last column are somewhat erratic, they show a far more constant amount of power per cubic inch for a wide range of diameters of drills than would be expected.

The diagram gives the relation between the feed and the total amount of power consumed for all the observations. The vertical scale gives the horse-power and the horizontal scale the feed in thousandths of an inch per revolution. The smaller figures just within the base line give the feeds actually used in the tests. The upper left-hand part of the diagram gives the data for the larger sizes of drills and for this a second set of horse-power figures is given. The figures for the feed are common to both parts of the diagram.

With but two exceptions the data for any one drill are strikingly concordant throughout the range of feeds, and are obviously represented by straight lines. The dots which represent the data for the different drills are distinguished from one another as indicated in the small tables which appear on the diagram. The two exceptions referred to are the ones for a feed of 47.4 thousandths on ½- and ¾-inch drills. The data for the ½, ¾, 1 and 1¼ inch drills form an extremely satisfactory and progressive set, but there is an abrupt change at the 1½-inch drill for which we have no explanation. The line for this drill begins at the left about where it should to continue the series, but it runs at a much steeper angle and this change in the angle appears to represent a change in the law as the lines for the larger drills are much more nearly parallel to the 1½-inch line than to the lines for the smaller sizes. The abrupt increase in the power required for the 1¾-inch drill appears, of course, on the diagram. Were the line for this drill drawn on the lower part of the diagram, it would be bodily above the others instead of below them where the lines for the ½, ¾, 1 and 1¼ inch drills indicate it belongs.

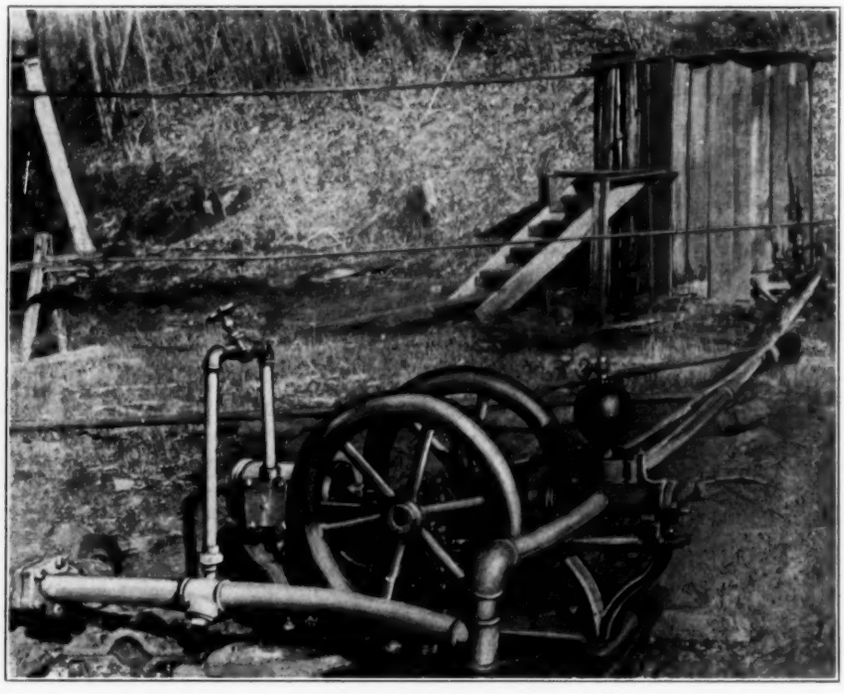
There is less appearance of a law connecting the different sizes in the upper part of the diagram than in the lower. The line for the 2-inch drill is below the one for the 1¾-inch, but the 2½-inch is above the 2-inch, while the 2¼-inch repeats this erratic angle of the 1½-inch. Differences of grinding, of sharpness and of quality in the drills themselves naturally enter into the data between different drills, while those factors are, or may be made, constant in all tests on any one drill. It is hence to be expected that tests between different drills will show more erratic results than tests of the same drill under varying conditions.

It may, we think, be accepted that these tests establish the fact that the law connecting the power with the rate of feed is a straight-line law.

Echoes from the Oil Country.

STARTING A JOB SHOP.

The boys had decided to go into business for themselves. Surely it was a good opening. Here was a building with engine and boiler, a machine shop with a couple of lathes, drill press, pipe cutter, vises, etc., and a blacksmith shop with steam hammer; no other shop within several miles, rent low, very low it seemed; oil wells in every direction, oil refinery just outside the door. The photographs will show some of the surroundings. If anyone wanted more of an opening than that he would be hard to please.



"AN OIL PUMP JUST DOWN THE HOLLOW A WAYS."

Besides all that, they could do most of the work themselves, for one of them was a fine blacksmith, while another had always been able to rank as a leading machinist in the shops where he had worked. Added to this, they were cheerful, pleasant fellows, well liked by their acquaintances, all of which would help to attract and hold work. Furthermore, they had been assured by those needing to have work done that they would certainly give them the preference on all work they were able to handle promptly. To make things still brighter they had been told at the shops and foundries in the neighboring city that they could buy anything they wanted, either rough, semi-finished or finished. That would give a large stock to draw from without having to tie up money in carrying it.

After deciding to go in, the boys still thought it wise to get all the pointers they could, and as they had been friends of mine for years they came to me and asked for my views of it.

"You know well enough, Will, that a fellow never has very much that always works for someone else. He gets a living, and whatever is made the other fellow makes. We are young now and can grow up with the business, just as you fellows did. We don't expect to get rich, but we hope to do a little better than days' work, and don't see any reason why we shouldn't, do you?"

"That depends," said I. "If you get lots of work, and charge enough for it, and collect in all you get charged up, and it doesn't cost too much to do the work and run the business, you may make a little. I understand you are going to buy the outfit and hire the building. My advice would be to hire next door to us or to one of the other shops here in town to start up. We would be glad to turn all the poor-paying, dirty jobs over to you that come our way, and I believe the other shops might have some they would do the

same with. All the work around where you are going to start would have to come here, and you would have a chance to get part of it, at least, and also a chance to catch every fellow that had a kick against any of us. As you get to know people here you have a much better chance to grow than up there. If you get stuck on some job, you don't need to go far for a little information if you're not too proud to ask for it. One thing let me tell you if you care for advice: Don't think for a minute that working so many hours at so much an hour is all there is to it. Watch carefully the hours that you are not working for anybody at any cents per hour, and watch how you charge. You are much more apt to not charge enough than to charge too much on most jobs."

In due time the new shop was running and some of our old customers began to tell us that we had a competitor up the creek and to hint at how cheaply they could get work done there and to intimate that we must keep down close or we might not be able to have things come our way. We had been through that several times before and felt more alarmed for our friends than for ourselves.

Several months after this, I had a call from one of the new shop owners who wanted some advice concerning some work he had taken in and which had turned out badly. I gave him what advice I could to help him out and also gave him a piece of my mind when I found out the price he had taken the job at, which was about half price. He thought he would have made money only for the bad luck. I used all my logic to convince him to the contrary.

"Who pays you for keeping a horse and buggy to get to town here and back with supplies and for the time you spend? Do you charge it to the job or to jobs in general? Well you should. Who pays you for the time you are keeping the books? Who pays you for the time you are chasing after the fellows that owe you? Who pays you for what you get on your books and can't get off?"

"I've begun to wonder about some of those things myself by this time. I keep the books and I know that everything is charged; but it don't seem to come out just right, somehow. I have been blaming my partner for not charging up all the time and material on his jobs, while he says he thinks it is either that I in the shop am forgetting things, or else I don't charge all he turns in." My friend looked worried. He had confidence in his partner, yet things were not all sunshine.

In a few days I saw the other man, and he wanted to have a little talk. He said they had talked over what I had told the other one, or at least what he had said I had told him, and it seemed a little strange. He described a job he had taken in the blacksmith shop and asked me to give an estimate on it. I thought $40 would be about right. He told me he had taken it for $23, and thought he was putting it high. Figuring material in the job and waste in making up, a reasonable amount of scrap for the ends of the bars, coal for the fire, steam for the hammer and engine, wages of helper and an extra man from the machine shop some of the time, as needed, and it would be close work to get any wages for the blacksmith, while if rent, depreciation, interest on money invested and insurance were taken into account, with a reasonable allowance for time lost in repairs, bookkeeping and talking to customers, my estimate of $40 would need to be increased considerably before there would be a margin for bad debts and a profit.

Before he left he began to see things in a somewhat different light, without seeing how to better them much. It is much easier to drop on prices than to increase them and still hold and enlarge the business.

They finally had to let go, when they found all their money tied up in book accounts. The few men they employed refused to take promises when pay day came while promises were much easier than money to get from some who owed them. They began to understand some of the reasons that the man who had run the shop before them did not keep at it. As they were young men the experience may be worth to them what it cost.

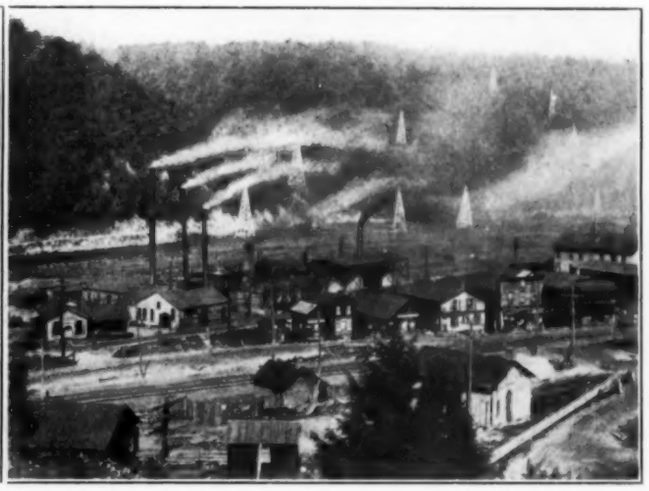
I once had an offer to take charge and run a small shop. I was to have full and complete control, with no rent to pay. On investigation I found it was a small shop and foundry and the owner was very willing to take anything that was left after I paid all running expenses. I got my salary (or wages) before he got anything; but there was no stream of money or help coming from him to me. The stream was to be all the other way, and I was to furnish both volume and speed if there was any. Glory and distinction might be lurking there, but I had the beginning of a large family to look after, and I thought wages might serve better than glory for that purpose. I declined the offer with thanks.

During one period, about fifteen years ago, when a great many cities and towns were paying bonuses for having manufacturers locate with them, a fellow worker endeavored to get me to join with him and a professional man and buy up a lot of old machinery for sale near by and seek our fortunes in the place willing to put up the largest inducements. I found he considered it a good chance to get a start with nothing to lose and everything to gain.

We did not start in on it. He thought I was timid, but later, when he took a shop where the owner had died and left what seemed like a nice opening, a few months' experience showed him a few things about running a job shop that were a little different from running a lathe. He isn't running it now.

The best place I know of to-day to get a thorough insight into the principles both of mechanics and general business management is in a job shop. The man who

UP SQUAW RUN. "OIL WELLS IN EVERY DIRECTION."



"OIL REFINERY JUST OUTSIDE THE DOOR."

can run it and make money can hold his own reasonably well in case it should grow a little; and he will find it easier to get and to please customers in the big shop than in the little one in many ways. So, if there is not so much money there, there is lots of experience to make up for it.

I've been there. W. OSBORNE.

The Drawing of Deep Shells from Sheet Metal.

BY JOSEPH V. WOODWORTH.

The manufacture of deep sheet metal shells of small diameters has progressed constantly, and to-day results are attained which a few years ago were only thought of as remote possibilities. The operation of drawing sheet metal shells has really changed but little, the same means, with slight modifications, being used at the present time for the production of deep shells of small diameters which formerly were only thought practical for producing shells of shallow depths and large diameters. The presses, in which drawing dies are used, have been built larger and stronger and with a greatly increased length of stroke, while the dies have simply been modified for a wider range of work.

As an illustration of what is being accomplished in the drawing of sheet metal, we show in Fig. 1 the successive results of the eight operations required to draw a shell from sheet copper 1-16 inch thick, 16 inches deep by 2 inches in diameter. Two of the shells are assembled and shown at the extreme right. They are used as parts of a patented mineral-water cooling apparatus.

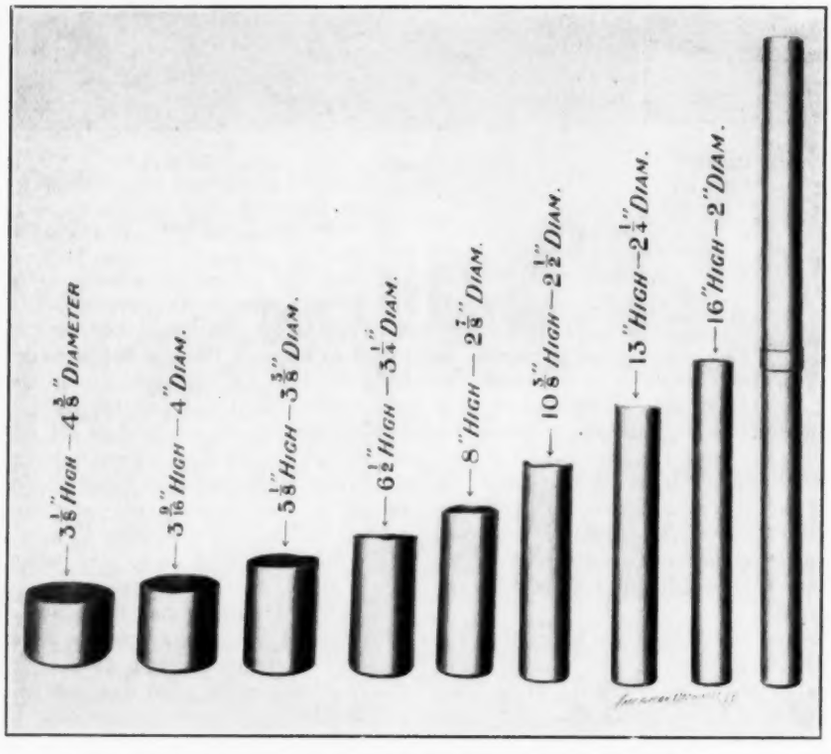

3 1/8" High — 4 3/8" Diameter
3 9/16" High — 4" Diam.
5 1/8" High — 3 3/8" Diam.
6 1/2" High — 3 1/4" Diam.
8" High — 2 3/8" Diam.
10 3/8" High — 2 1/2" Diam.
13" High — 2 1/4" Diam.
16" High — 2" Diam.

FIG. 1. DIFFERENT OPERATIONS IN DRAWING COPPER SHELLS.

The blank required for this shell was 8 inches in diameter, and the thickness of the stock decreased from 1-16 at the start to 1-32 at the finish. The die used for the cutting and first drawing operation is shown in Fig. 2, and is of the double-acting type. In the punch the cutting and blank holder part is a forging of wrought iron with a tool-steel ring welded on as shown for the cutting portion. The projection *B* is for locating it true on the outer slide of the press. *A* is the drawing punch, the stem of which is reduced as shown to fit the inner slide or ram of the press.

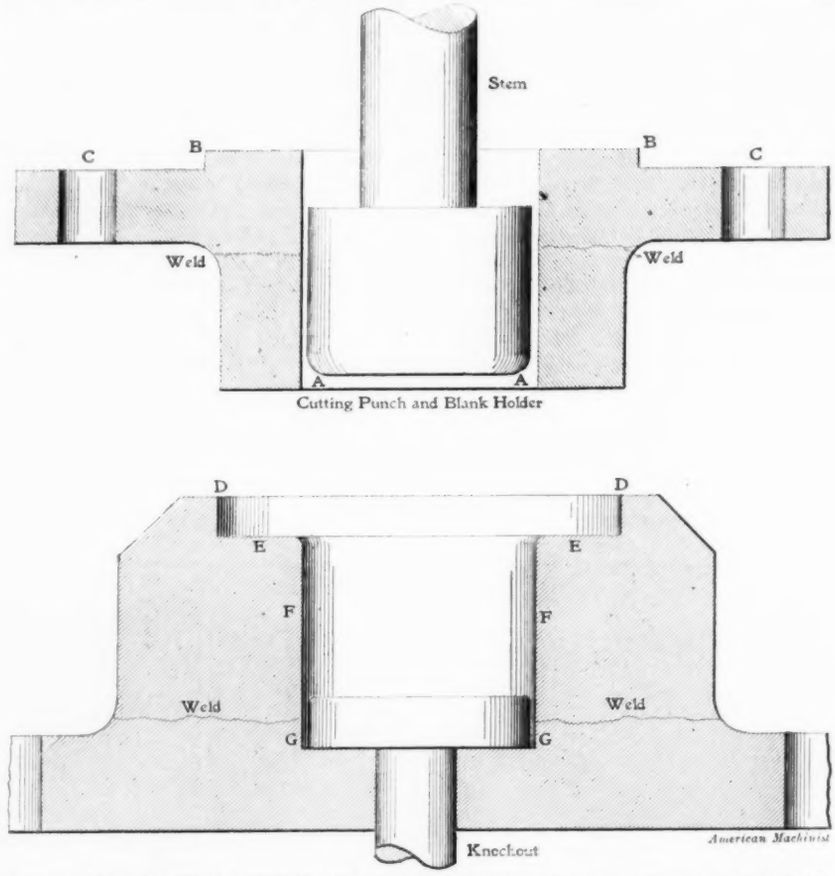


FIG. 2. DOUBLE-ACTING CUTTING AND DRAWING PUNCH AND DIE FOR FIRST OPERATION.

In the die, *D* is the cutting edge, where the blank is cut; *E* the face upon which it is held by the punch while being drawn, *F* the drawing die and *G* the knockout pad. This die is set up in the press and the metal is fed to it and blanked and drawn to the shape shown in the first operation in Fig. 1. The press has a toggle movement which insures a more perfect "dwell" of the blank-holder slide than could be maintained in a cam drawing press, and effects a large saving in friction and power. The adjustment of the drawing punch plunger is effected by means of a double-ratchet device, which is handy and quick of operation.

For the seven redrawing operations in the production of the shell, dies of the type shown in Fig. 3 were used. These dies were of the push-through type and were used without the usual inside blank-holders, as the small differences in the diameters of the redrawn shells did not require it. Instead of the shell being pushed completely through these dies, they were fed to the top of the die by an automatic knockout on the press in which they were used.

By noting the differences in the diameters of the redrawing operations, Fig. 4, the manner in which a shell of small diameter and great hight may be drawn and the number of operations required will be understood. The lubricant used in the redrawing operation was lard oil, and there was a decided polish on all the shells produced. The dies used for the redrawing operations were made from a special grade of chilled iron, while the punches were of tool steel. Both punch and die for each operation were highly polished. The die and punch used for the sizing or finishing operation were of tool steel, and were hardened, ground and lapped to the required size. As will be seen, the drawing of deep tubes of small diameters is not such a difficult accomplishment as some people imagine, all that is necessary being the adoption of proper dies, their accurate construction, and their use in presses which have been built specially for such work. When the difference in the diameters of the redrawing operations exceeds ½ inch, inside blank-holders must be used. For certain metals inside blank-holders in the redrawing dies will allow of the desired results being accomplished in three or four operations (through the perfect holding of the metal while drawing or redrawing), which would require six, seven or more operations were dies adopted in which inside blank-holders were not used.

Fig. 5 shows the tools used. The punches are reduced at the end and threaded to screw into the holder in the press ram. The dies are shown beneath the punches, and the locating seats in each are shown plainly. The devices shown at the bottom comprise the knockouts and other tools.

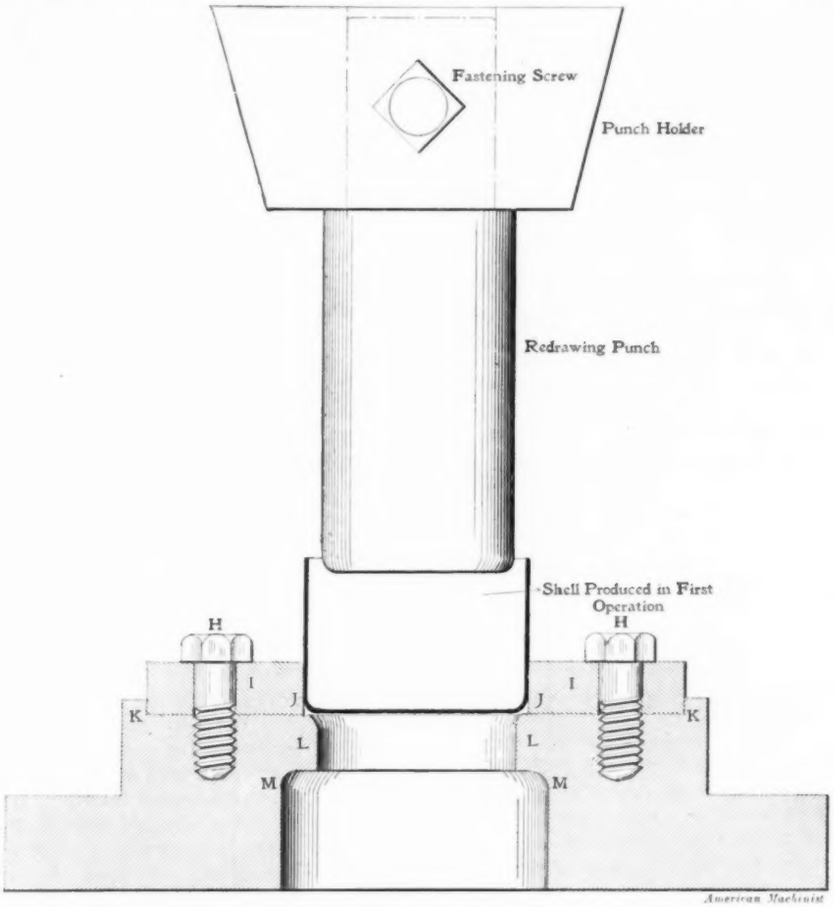


FIG. 3. REDRAWING PUNCH AND DIE WITHOUT INSIDE BLANK HOLDER FOR THE SEVEN REDRAWING OPERATIONS.

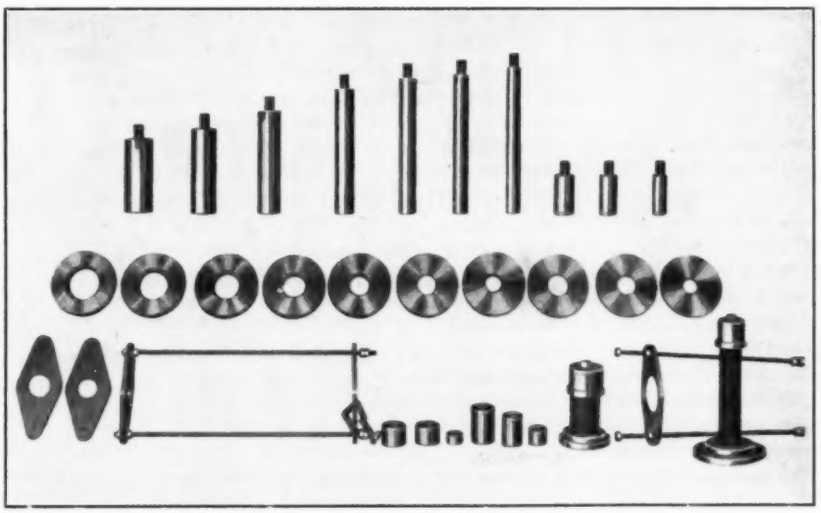


FIG. 5. DRAWING PUNCHES AND DIES, KNOCKOUT DEVICES AND OTHER TOOLS USED FOR THE PRODUCTION OF THE SHELLS.

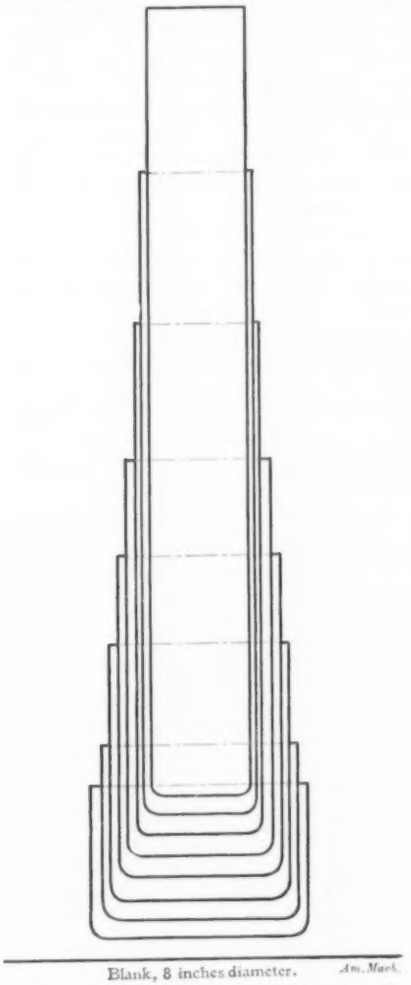


FIG. 4. RESULTS OF THE EIGHT OPERATIONS.

The Clean Blacksmith Shop—Does it Pay?*

It is just as essential that we have a clean shop as it is that we have a clean life. We look to our superior officers sometimes for example. The general manager's office is kept clean, why not the blacksmith shop? Many will perhaps

*H. R. Looker, Foreman Blacksmith Ann Arbor Railroad before the N. R. R. M. B. A. at Chicago meeting.

consider this no comparison. Why not? If it is good for one, most certainly it is for the other. In a clean shop we find clean men, clean work, reliable work. A system prevails here that teaches a man to be honest. And there is plenty of room for this kind of teaching, look in whatever direction you may the world over.

Material used in railroad smith shops is expensive and must be handled with care. Every piece of forging must be able to bear the strain laid upon it. Durability is economy; where good judgment is used cleanliness teaches economy. Forgings today are made far more scientifically than in the past. The time was when the men who would wield the heaviest hammer executed the most work, but through the ever increasing ingenuity of the thoughtful smith muscle has been discarded, steam and air have taken its place, and more work is being done to-day in five hours than could be done in five months a few years ago.

Many smith shops are dark places, mostly on account of dirty windows or skylights. Blacksmiths have not grown tender on account of living in greenhouses, but we know their lives could be made brighter, their faces whiter, if our shops had more light. Blacksmiths can live in glass houses for they throw the fewest stones; they strike the best blows; they pile up, heat up, blow up, but never explode.

Many a smith could testify that when he

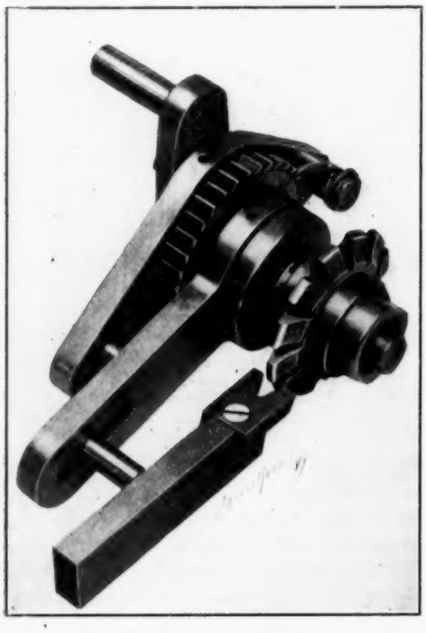


FIG. 1. DEVICE FOR BACKING-OFF MILLING CUTTERS.

had done his utmost to make a forging look complete and perfect, and as near to the required dimensions given him as it was possible for him to see, upon viewing it again in a shop where there was more light, or upon seeing it outside, he was disgusted with his own work. Blacksmiths only die once, but they would prefer to do this than to accept a "turkey" from an employer who expects good work done in a dark shop. Let our shops be kept clean, light and filled with pure air. We have heard of the air being made blue sometimes, not with smoke, nor the reflection of the blue sky, but from a dirty tongue—a foul mouth. A foreman loses all the respect men have for him when he gives way to this dirty habit of cursing and swearing. A shop is not clean where this exists. Let a little sunshine in.

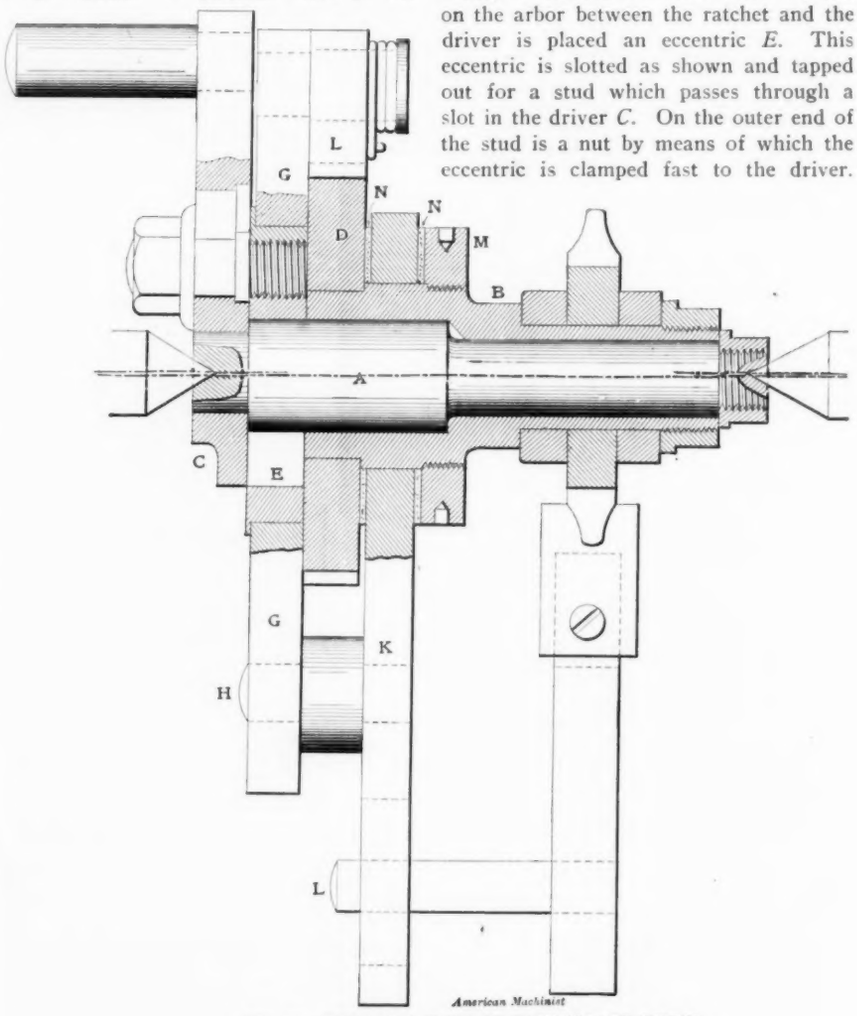


FIG. 2. SECTIONAL VIEW OF BACKING-OFF DEVICE.

Improved Device for Backing Off Milling Cutters.

Gus. C. Henning, of 206 Centre street, New York city, is now the manufacturer of the Balzer backing-off device for milling cutters, described in our columns in 1895. This device has been improved recently, and in the accompanying illustrations the new arrangement is shown.

The half-tone, Fig. 1, gives a good idea of the appearance of the improved device, and the sectional view, Fig. 2, clearly shows its construction.

Referring to Fig. 2, it will be seen that the arbor *A*, which may be placed between the centers of any lathe, and upon which is mounted the sleeve *B* for the cutter, is provided with centers that are slightly eccentric to give the cutter the necessary movement to and from the forming tool held in the lathe tool-post. The arbor is rotated by the driver *C*. This is fastened on the end of the arbor and provided with a pin that enters a slot in the face-plate on the lathe spindle. On the inner end of the sleeve, which is a running fit on the arbor, is fastened a ratchet wheel *D*, and on the arbor between the ratchet and the driver is placed an eccentric *E*. This eccentric is slotted as shown and tapped out for a stud which passes through a slot in the driver *C*. On the outer end of the stud is a nut by means of which the eccentric is clamped fast to the driver. The rocker G is bored out to fit the eccentric and is slotted at the end to slide on a pin *H* driven in the arm *K*. At the other end of the rocker is a stud on which is carried a pawl *L* that engages with the teeth on the ratchet wheel fastened to sleeve *B*. When the arbor *A* is rotated, the rocker is operated by the eccentric and the sleeve and cutter are turned through a part of a rotation.

The arm *K*, already noted, which is slotted at the end to fit on pin *L* in the tool-holder, is bored out to slip on the sleeve *B* and held between two friction washers *N N*. The nut *M* at the right being adjusted properly, sufficient friction is created to prevent the sleeve and ratchet wheel from turning except when acted upon by the pawl.

The eccentric, being adjustable, is set so that the cutter will be turned ahead one tooth to each turn of the arbor. Thus as the latter rotates, carrying the cutter

off center, each tooth is in turn brought forward against the backing-off tool. After a cut has been taken from each tooth the tool is fed in by the cross feed screw for another cut; this, of course, being repeated until the backing-off operation is completed.

The ratchet wheel has thirty-six teeth, and as the eccentric may be set to throw the pawl one, two, three or four teeth, cutters having nine, twelve, eighteen or thirty-six teeth may be backed off on the device.

Correspondence Instruction in Drawing.

There are not many books on mechanical drawing which the practical draftsman feels are satisfactory. With all their effort they somehow fail to "get there." We have just seen a copy of the instruction paper on this subject which is put out by the American School of Correspondence (prepared by C. L. Griffin) and feel bound to say that we have found an exception to the rule. Indeed it is not too much to say that in the methods followed it stands in a class by itself. By permission we make a few extracts from the pamphlet, which will indicate its methods better than any description which we could give:

"Method of Procedure.—As the general objects to be attained in a working shop drawing have now been presented, it is necessary to indicate in detail how the work may be properly accomplished. In order to do this, it is proposed to produce systematically a full set of working drawings of a familiar and comparatively simple machine. The methods used will be those of a designing detail draftsman, producing commercial work fit for shop use. In the progress of the work, from its beginning in the rough, though accurate, pencil layout, to the completion of the tracings and the order sheets, the same bold style, clearness, directness and businesslike spirit which the shop atmosphere and surroundings would naturally supply, will be emphasized, and so far as possible imparted to the student. It is expected that the student will follow the text closely and study the plates carefully, endeavoring to familiarize himself with every detail illustrated. The more closely he is able to apply himself in this respect the more will he be able to partake of the life and spirit which is intended to be conveyed, and without which the true character of the work can be but poorly developed.

. . . . . .

"The discussion in the text, of not only the form of the machine parts themselves, but also the tools and shop processes to produce them, affords considerable insight into the influences affecting good machine design. Without introducing any mathematical analysis or investigation, which is beyond the province of this book, much practical consideration as to the restrictions imposed by existing shop methods upon theoretical construction will be suggested, and the student encouraged to use his judgment thereon.

"In the preliminary layouts the actual 'sketchy' appearance of the pencil drawing will be imitated as far as possible, so that the student himself may imitate and catch the bold dash, yet fine accuracy of the line-work, which is characteristic of the expert draftsman.

. . . . . .

"The typical set of plates chosen for this book in fulfillment of the above purposes, takes up the study of a simple duplex steam pump.

. . . . . .

"Plate A. Steam End Layout.—This plate illustrates, as nearly as reproduction can accomplish, the pencil layout of the steam end. It is the first work of the designing draftsman. The drawing as shown is exactly the type of layout which he would turn over to a detail draftsman, whose duty it would be to work up detail shop drawings therefrom.

"The character of this drawing should be carefully studied. Remember that it is a layout, nothing more; also bear in mind that it is an exact, measurable working sketch. Attention is called to the sharpness of the lines, especially to the clean-cut intersections. Note the boldness, dash and businesslike style, the freehand cross-section lines roughly put in. There is no hesitation or worry as to where the end of a line shall be, or whether it crosses other lines which it theoretically should not. The intersections are allowed to indicate the termination of lines, and the rough section lines pick out the parts and separate them clearly to the eye. There is the spirit in this layout of confident, definite and rapid action, with no thought for absolute finish in line-work, but with every thought for absolute results as to measurable dimensions.

. . . . . .

"There are two general rules of action in producing a drawing which give the answer to the question which oftenest confronts the beginner: 'What is to be done first?' or 'What is to be done next?' These rules are: 1. Draw everything that is positively known. 2. Work from the inside to the outside.

"Every problem has some positive data assumed or calculated to start with. The first thing to do in every case is to get these data represented by lines on the paper. . . Almost invariably the first line to draw is a horizontal center line; draw it! Draw it at once without hesitation and the layout is begun. We now have something about which to build.

. . . . . .

"If the student will only appreciate this one rule and draw all he knows about the problem, he is well on his way to its solution. *Draw everything you know, and work for what you don't know,* is what these two rules say, and the first question to arise should be: 'Have I drawn everything that is known about the problem?' before he asks himself or anyone else: 'What shall I do next?'

"One other rule might be added to these two: *Keep dimensions in even figures, if possible.* This means that small fractions should be avoided. It is just as easy to bear this point in mind, and save the workman much annoyance and chance of error, as it is to disregard this matter. Even figures constitute one of the trade-marks of an expert draftsman. Of course, a few small fractions, and sometimes decimals, will be necessary. Remember, however, that fractions must in every case be according to the common scale; that is, in sixteenths, thirty-seconds, sixty-fourths, etc.; never in thirds, fifths, sevenths, or such as do not occur on the common machinist's scale.

"A systematic, definite mode of treatment on these lines must become a habit, so that all problems, however complicated, can be approached with confidence in the same way. It is the drawing of one line which makes clear the drawing of the next and subsequent lines; and the most serious obstacle which the student is likely to set for himself is trying to see the whole problem through from the beginning. Even an expert cannot do this, but allows the layout to develop results as he proceeds."

. . . . . .

Following these admirable explanations the detail drawings are taken up. A complete working drawing of the cylinder and head are shown, but without dimensions. The instructions for this are as follows:

"The steam cylinder and head, however, as shown in Plate G, are not dimensioned, and the student's problem is to produce this plate complete, with finish marks, dimensions and necessary data for a working drawing. In order to do this it is first necessary to work up Plate A with exactness, in pencil, and see that all parts go together properly. Then the detail of cylinder and head may be made separately by measurement of the layout drawing, and Plate G produced."

. . . . . .

As we understand it, the detail drawing thus made by the student is forwarded to the school for criticism, and in this way the teacher gets in personal touch with the student's work.

"Plate G. Steam Cylinder.—After the exact and complete development of the steam-end layout, the student should be pretty thoroughly acquainted with the details of the cylinder. All the work thus far has been entirely for *his own* information, to get his ideas in visible shape, so that he himself can have a permanent record of them. This layout, however, is not in suitable form to finish up into a detail drawing. Its sketchy nature and the confusion of parts, especially if attempt were made to add dimensions, would render it somewhat difficult to be read by a workman taking it up as an unfamiliar subject. Hence it is now necessary to separately

detail the parts, with the object in view of transferring, in the simplest and most direct manner, specific information to the workman which will enable him to construct the several parts. It is not enough now that the drawing be clear to the man who makes it; it must be clear, *absolutely clear,* to the shop mechanic, who has no means of knowing the designer's plans except through the information which the drawing gives on its face.

"This requires that the draftsman should put himself in the workman's place, and forestall, by the explicit nature of his drawing, all possible questions which may arise in the shop. In this way only can he hope to avoid errors of construction and the continual annoyance of endless explanation of his orders.

"Plate G is to be a finished drawing, and the first thing to do is to lay out the sheet.

. . . . . .

"The general arrangement of the sheet, number of views and approximate space occupied, should be blocked out first. This can easily be done from the original layout. In general, several cross-sections are preferable to a single view, which involves many dotted lines. Dotted lines are very convenient for showing invisible parts of an object, but they are often abused, and the drawing of a complicated piece made indefinite and confused thereby. As already stated, a working shop drawing is solely to convey information to the workman at the least possible cost. A careful consideration of this will settle the question of the number of views necessary, their character and the amount of dotted line work desirable.

"Never let the drawing become the master; always be master of the drawing. Do not draw an extra view if no use can be seen for it. Do not put in dotted lines if the detail is completely shown without them. Full lines, or lines which show visible portions, must of course be shown completely.

"The nature of the pencil work on Plate G should be the same as on the original layout, viz.: sharp, definite lines and positive intersections. Above all things learn the habit of accurate workmanship, for it will save many errors and a vast amount of time. The draftsman must check himself at every line he draws. Slight errors in scaling will often throw parts out of proper relation to each other, and interferences, which the drawing does not show, will become apparent only when the parts get into the machinist's hands.

"It is dangerous practice to project across from one view to the other. It only takes a slight irregularity or spring in the T-square to vary the location of lines very perceptibly from where they should be, and once out of scale from this reason it is almost impossible to work a view with any certainty. Rather than project across from view to view, the principal lines, at least, should be scaled off on each view, and it will be found that in the end time will be saved and greater accuracy secured.

. . . . . .

"Do not be afraid to use the eraser. The draftsman who hesitates to draw until he is positive that no change will be necessary, is likely to spend the greater portion of his time in unprofitable dreams, for he is attempting the impossible. A drawing is a means, not an end; and, as has been already pointed out, it greatly assists the draftsman in clearing up many doubtful questions which the imagination alone cannot do.

"A bold attack of a problem shows the quickest path to its solution, even if lines must be erased again and again. It is a sign of serious lack of ability to hesitate in the use of pencil and eraser.

"Attention is called to the simple, straightforward character of Plate G. Notice the almost entire absence of dotted lines; the enlarged section through the ports, giving ample opportunity for dimensions without confusion; the use of a half end elevation and a half cross-section—the one to make clear the flange and bolt layout; the other to show the exhaust opening, the small auxiliary views (drawn at convenient points) of the exhaust flange layout, the cylinder foot and the drip boss.

"A steam cylinder is a fairly complicated casting; and it would be an easy matter, by the use of elaborate views, the dotting in of parts already completely shown, and careless line work, to rob this drawing almost entirely of its clearness and directness of illustration. *Just what is necessary* (for clearness' sake) *and no more* (for cheapness' sake), is the whole matter in a nutshell, and is what determines its shop and commercial value.

. . . . . .

"As in the original design of a piece so in the figuring of it, the draftsman must as far as possible put himself in the place of the workman, judging the methods and processes of construction and available tools. This will largely influence the arrangement of the dimensions. Of course it implies considerable experience in shop work, which some students do not possess. He can begin none too early, however, to learn to look at his work from the shop standpoint, and surely make it some better on that account."

If this is not effective instruction then we do not know the article.

The London & North-Western locomotive, "Charles Dickens," has recently completed its two-millionth mile. American engineers will please take note.—*The Engineer.*

The Librarian of Congress at Washington wishes to obtain for the library Vol. 1 of the AMERICAN MACHINIST and Nos. 1, 3, 4 and 6 to 12 of Vol. 2, Nos. 1 to 19 and No. 21 of Vol. 3. We are not able to supply them, and the Librarian would be glad to hear from anyone who can do so.

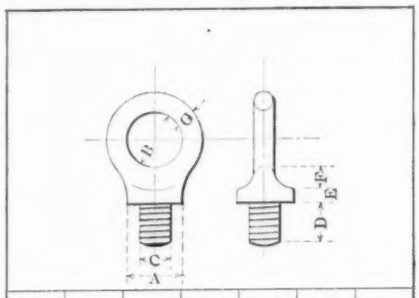
Letters From Practical Men.

Dimensions of Eye Bolts.

Editor American Machinist:

In looking over my scrap book of standards, many of which were taken from the pages of the AMERICAN MACHINIST, I came across the enclosed one, which I thought might prove of some value to your many readers.

I have used this design for both steel



A	B	C	D	E	F	G
⅜″	2″	¾	⅞″	3/16	⅜	5/16
½	2⅛	1″	1″	¼″	½″	⅜″
⅝″	2¼	1¼	1⅛″	5/16″	⅝″	½
¾	2⅜	1 5/16	1¼″	5/16	11/16	5/16
⅞″	2½	1 11/16	1⅜″	⅜	¾″	⅝″
1″	2¾	1⅞″	1½″	7/16″	⅞″	¾
1⅛	2⅞″	2⅛″	1⅝″	½	1″	11/16
1¼	3	2⅜	1¾″	½″	1⅛″	⅞
1⅜	3⅛″	2⅝	1⅞″	9/16	1 3/16	1″
1½	3¼	2¾″	2″	⅝″	1¼″	1 1/16
1⅝	3⅜	3	2⅛	11/16	1⅜	1⅛
1¾	3½	3¼	2¼″	¾″	1½	1¼
1⅞	3⅝″	3½	2⅜″	13/16	1⅝	1 5/16
2″	3¾″	3¾	2½	⅞	1¾″	1⅜″

American Machinist

DIMENSIONS OF EYE BOLTS.

and composition, and have always found it strong and to give the greatest satisfaction wherever used. STEELTON.

Cutting Oils.

Editor American Machinist:

I should be much indebted to any of your readers who would favor me, through your valued columns, with a few notes regarding the action of oil as used on the cutting tools of automatic lathes. Is the oil principally a lubricant or a cooling agent? In other words, is it a preventive or a cure of heat-generation? In either case, how does it fulfill its function? Why is the surface of work turned under a flood of oil so much smoother than if it were cut dry?

I should also be glad to know of some simple tests for ascertaining the suitability or otherwise of a given sample of cutting oil. At present in the works where I am engaged we use a mixture of one part lard oil to two of common oil, which gives satisfactory results on plain, unscrewed work. We are always open, however, to

consider any means of improving or cheapening our output; and so when a seller comes along offering us a new mixture with many plausible promises, while we are disposed to listen to him, we wish to be able to verify his claims before giving him an order. W. G. T.

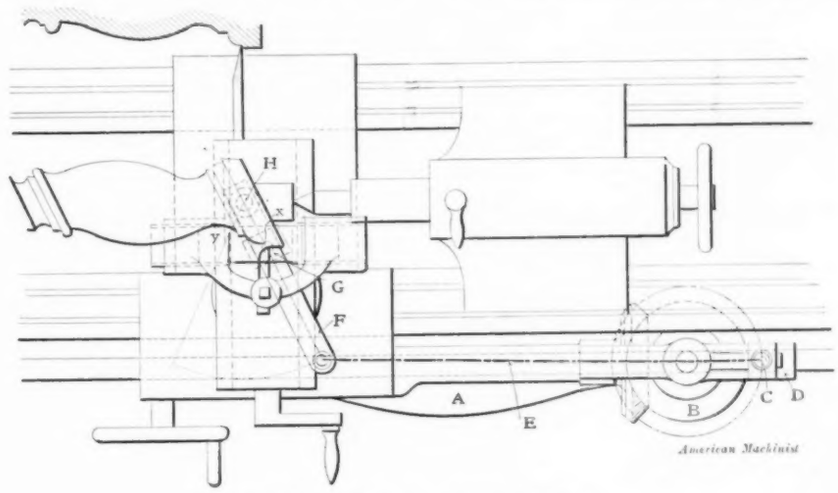
Manchester, England.

Swash Turning.

Editor American Machinist:

In offering an answer to your question, at page 1168, "Who knows about swash-turning?" I will not here claim to give the exact method employed for doing such work, nor even a method that has been tried and proven efficient. By the enclosed sketch I aim, however, to show a way in which it might be done, and, lacking information to the contrary, I would not at all mistrust the results obtainable by operating in this line.

As the sketch may not be clear enough to be understood, I will submit the following explanation. In producing turned work of this character it is evident that the path of the cutting tool, relatively to the work, instead of being a circle perpendicular to the axis of the work as in common turning, must be an ellipse, oblique to the axis of the work. Therefore what is required is simply to arrange the proceedings so that during each revolution of the work the tool travels backward and forward the proper amount on a line parallel to the lathe axis. This reciprocating motion can of course be produced in various ways, of which the sketch shows one, perhaps simple enough to be practical.



LATHE ARRANGED FOR SWASH TURNING.

On the lathe-apron we secure a bracket *A* which carries a pair of bevel gears. Of these, the driver gets its motion from the feed rod, in such a manner that the driven gear *B* turns coincidently with the live spindle. The pin *C* on the adjustable arm *D*, which is connected to the second gear *B* through a vertical shaft, will therefore transmit a swinging motion to the arm *F*, by means of the rod *E*. This rod should be of sufficient length not to introduce undue error in the oscillations of the arm, which oscillations should be in unison with the rotations of the work.

The angle through which the arm oscillates determines the obliquity of the turned work and will have to be varied to suit the different requirements.

The swinging arm is pivoted at *H* on the apron-plate, in the center between the ways, and drives the slide which carries the tool-post. This slide is guided at the ends and bridged across in order to allow the arm to swing between the guides.

The tool is adjusted so as to be in line with the driving block *G;* that is, when the driving block is at the center *H* and receives no reciprocatory motion from the swinging arm, then the tool also is in the lathe axis. The reciprocating movement of the tool therefore equals o at the axis and increases, as it is drawn back, at the same rate as its distance from the center increases.

From this it is evident that, with an arrangement similar to the sketch, the tool will start its cut, for instance at *x;* after the first half turn it will be at *y*, and after the second half turn it will be back again at *x*, ready for the next cut in the same zigzag circuit, and so on.

To facilitate the reproduction in numbers of a certain pattern, we can arrange back of the work a templet of the desired shape, against which a pointer, fastened to the tool-rest, is guided when finishing the work. GESTRIC LAND.

Squares of Fractions and Mixed Numbers.

Editor American Machinist:

Finding the square of a number is always a tedious operation and advantage is generally taken of the numerous tables of squares, but these do not apply directly when the square of a fraction or a mixed number is wanted. The short table of squares of fractions here given is frequently used, covering the cases most commonly arising, and it is well to insert it in a book which gives the squares of whole numbers.

For the square of a mixed number, let the integer part equal *a* and the fractional part equal *b;* then, since $(a + b)^2 = a^2 + 2ab + b^2$, the square of the whole number can be taken from any table of squares, the square of the fractional part from the table here given, and to their sum add double the product of the fraction by the whole number. Example: Required the square of 27 1-16 = $(27.0625)^2$.

Fract'n	Decimal	Square	Fract'n	Decimal	Square
1/16	.0625	.0039		.55	.3025
	.1	.01	9/16	.5625	.3164
1/8	.125	.0156		.6	.36
	.15	.0225	5/8	.625	.3906
3/16	.1875	.0351		.65	.4225
	.2	.04	11/16	.6875	.4727
1/4	.25	.625		.7	.49
	.3	.09	3/4	.75	.5625
5/16	.3125	.0977		.8	.64
	.35	.1225	13/16	.8125	.6601
3/8	.375	.1406		.85	.7225
	.4	.16	7/8	.875	.7656
7/16	.4375	.1914		.9	.81
	.45	.2025	15/16	.9375	.8789
1/2	.5	.25		1.	1.

SQUARE OF FRACTIONS.

From the table of squares of whole numbers..... $27^2 = 729$.
From the table of squares of fractions..... .....$.0625^2 =$ .0039
Doubling the fractional part and multiplying by 27.... = 3.375

732.3789

The above method of finding the square of a mixed number will appear to many persons who have never tried it as rather more cumbersome than direct multiplication, but such is not found to be the case in practice. It is very generally followed by those who have given it a fair trial. Most calculators can take these figures from the tables in less time and with less risk of error than they can perform the long multiplication necessary in finding the square directly.

GERALD E. FLANAGAN.

Ejectors Worked by Water.

Editor American Machinist:

The very rainy summer we have had and the many cloudbursts and the like call to mind a similar season in New England when many of the shops along the Nashua River were flooded and had to be pumped out, mostly by hand. I have noticed similar performances this year in railroad yards, where the drop pits seem to gather in all the spare water for some distance, and are usually pumped out with the long tin barrel arrangement used by plumbers, who evidently measure the length of the barrel in making out the bill.

This seems to be an excellent place for the ejector to come into play and doubtless

more of them would be used if it were not for the trouble of getting steam to them. But why use steam?

I know of many cases where ejectors have been made for just this kind of work, but with the nozzles proportioned to use water at the city pressure. This means that the ejector can be carried anywhere and coupled up with a piece of good, strong hose, and it beats all the hand pumps out of sight.

The first cost is low and the satisfaction of knowing that you can handle anything of the kind that may come up is worth something.

Few seem to realize that jet apparatus can be worked by anything but steam, and this is of course true with some of it, but an ejector will do good work under the conditions named and be very satisfactory.

They are equally good for private houses if you are troubled with a damp cellar. Just drain the water all to one place and drop in your ejector with a suitable outlet and it will take care of it.

FRED H. COLVIN.

Return Bend Pattern on Molding Machine.

Editor American Machinist:

I send you herewith a sketch of a return bend pattern fitted to a molding machine. I have found this class of work very interesting, and I am sure it will prove so to fellow-patternmakers. I do not intend going into detail, but just show the general construction of pattern and stripping plate for a cast-iron return bend. *A A* is the pattern, made the same as an ordinary pattern for the purpose. The cope and drag are both made on this, and when the flask is put together it forms a mold for two bends. *B* is the stripping plate. *C* battens, *D* thickness piece screwed to *C* to rest in plate *E*. *E* is the pattern plate with battens *F*, to which distance piece *G* and pattern *A A* are screwed, also a support for stripper *B* when ramming the mold. *H H* are stripping plates screwed to stools *I I* resting on plate *J*, *K K* battens, *L* strengthening piece, *M* core prints, *N* gate. *C*, *E* and *J* are fitted to the molding machine frame. Fig. 1 is a plan of stripper and pattern, and Fig. 2 is a section through the center line. MOLDING MACHINE.

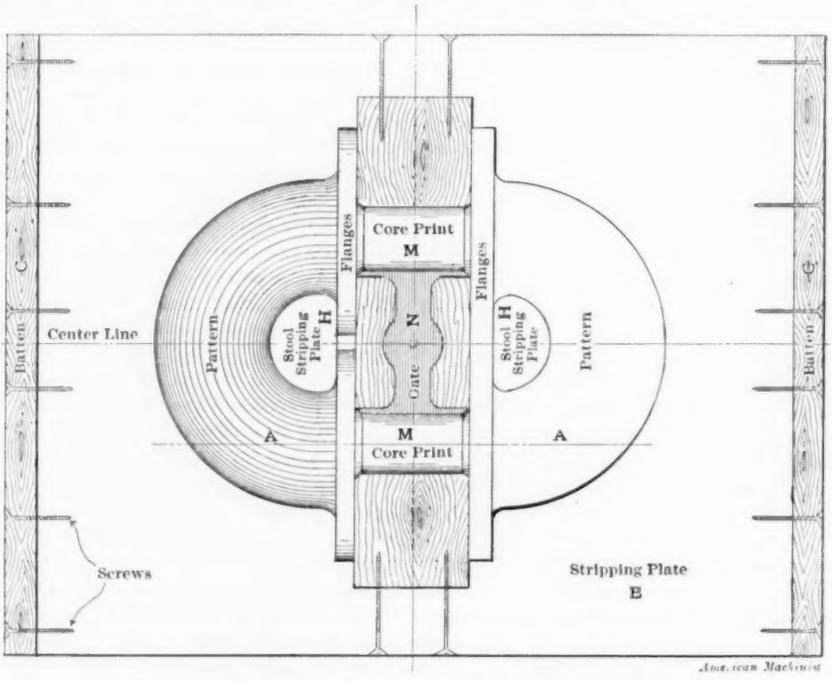


FIG. 1. PLAN OF STRIPPING PLATE AND PATTERN.

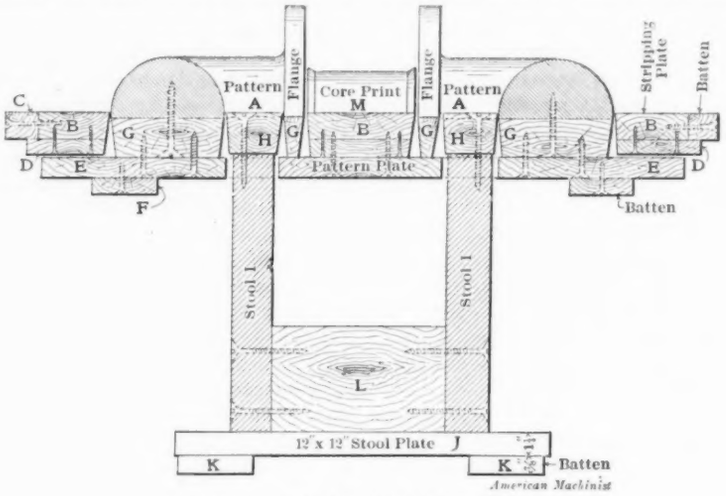


FIG. 2. SECTION ON CENTER LINE.

Chucking Small Screws—Locking a Cap-Screw—Pay for Wasted Time.

Editor American Machinist:

Having noticed in a mechanical paper a chuck for holding filister head screws while turning the points, I thought I would send my way of doing it, which is simpler. It is to take a piece of cold-rolled stock larger than the head of the screw, drill a hole through the center and tap it for the size screw you wish to use in it. Split it on one side, and it is ready for use. Very frequently you can get a set-screw the right diameter from the stock-room, but it is much too long. Armed with this tool, a long screw can be cut off with the hacksaw or placed in this threaded and split sleeve, and both held in the chuck, it can be cut off and a flat, round or cupped point produced in short order.

. . . . . .

A method of locking a cap-screw which shows its determination to evade its responsibilities and back out is to drill a small hole through one side of the head of the screw, parallel with the screw, and into the metal under the head after it has been screwed tight. Drive a piece of soft wire into the hole, upset slightly with a drift and you have a job that you "won't pull apart with your teeth." When you do need to take it apart, drill out the wire and the screw can readily be removed.

. . . . . .

Mr. Osborne's tales of an outside man and the things he did remind me of another outside man and the things he *didn't* on one occasion. One Saturday afternoon the foreman said to him, "Tim, go around to Pine's planing mill in the morning and put a new pulley that I sent over to-day on the jackshaft." Tim was on hand Sunday morning and got the shaft out and a couple of other pulleys off the shaft to allow the new one to go in the proper position. Then he attempted to put the new pulley on, but, alas! the lathe hand had sadly erred in his measurements, for it was a lot—a whole lot—too small. Tim wrestled with that pulley conscientiously, but to no purpose. The hub was long; the bore, though small in diameter when compared to the shaft, was large in area compared to a file, and the shaft went back into its place without the new pulley, for the mill had to be ready to run Monday morning.

Next morning the boss came to Tim and says he:

"Well, Tim, did you go over to Pine's yesterday?"

"Yes," said Tim.

"Get the pulley on?"

"No."

"How long did you work at it?"

"All day."

"What!" shouted the boss, "all day?" and visions of collecting double time from Pine's for doing nothing at all came before him. "And how in —— do you suppose I am going to get my money for that kind of work?"

"Shure divil a hair do I care," replied Tim, "but I must have moine."

JOHN SCOTT.

In Defence of the Draftsman.

Editor American Machinist:

I don't know that this subject is a particularly timely one, although some of the discussion of drafting-room practice lately printed in this paper has carried with it a delicate flavor of long-suffering patience with the asinine stupidity of the draftsman. My chief reason for saying anything about the matter, however, lies in a recent experience of mine in which a shop man exhausted on me his vocabulary of pet names because I didn't know enough about mind reading to know that he had changed his plans.

As an apprentice and a journeyman machinist, I have done my share of "cussing" at the designer who puts holes where you have to use an offset drill to get at them and nuts where they are so cramped for room that even a 15-degree wrench will not turn them. I offer no excuse for blunders of this kind, but he is a genius indeed who can design the simplest machine so well that years of constant service in the hands of intelligent workmen suggest no improvements. This draftsman, at least, lays no claim to such perfection.

I have seen shop men, promoted to the drawing board on account of their genius for finding imperfections and errors in completed machinery and fixtures, chewing the butt end of their pencils in silent dismay, and wondering why in the name of all that is lovely they can't seem to draw anything that doesn't look amateurish and unmechanical. Perhaps a few days' treatment of this kind would convince even the worst of chronic kickers that any old fool can see a mistake when it is embodied in cold cast iron and fairly comes up and hits him in the face; but, friends of the shop, it is a little more difficult to trace interferences and such like through the misty maze of pencil marks on the assembled drawing of a complicated machine. Try it and see.

EBEN BONES.

Roughing Gage.

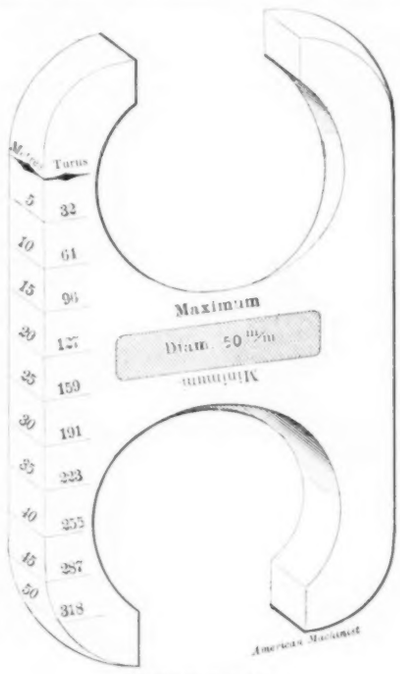
Editor American Machinist:

The enclosed sketch shows the gage or caliper we use in our works for the roughing of pieces, especially since we have the large Norton grinding machine.

As this machine allows us to take off a great amount of stock in a very short time, we rough our work rapidly, leaving it from ½ to 1½ m/m too large.

So that the turner may be well acquainted with same, and the foreman may watch over the rapidity of the roughing work, we use the idea of one of our young pupils, Mr. K. de Tramasure, and each caliper bears the number of revolutions the piece must make for a given circumferential speed.

Thus we may choose the greatest possible speed according to the quality of



ROUGHING GAGE.

metal, stiffness of the piece, the feed we will give to the tool, thickness of the cut and the quality of the tool steel.

Brussels, Belgium. A. BOLLINCKX.

A New Phase of Machine Design.

Editor American Machinist:

When I read your article, "A New Phase of Machine Design," at page 1284, I had to smile, and, with your kind permission, I will explain in a few lines the cause and give the reasons why I had to smile, and at the same time it may be of interest to your readers if I explain why this "new phase of machine design" is not practicable.

Let us first investigate the principle, the cause, the purpose that underlies the designing of a new machine.

Most, if not all, machines are designed to meet certain specifications. The man who orders the machine wants it to perform a certain kind of work in a certain *time*. He does not care *how* the work is performed; this is the designer's part to look out for, but he cares very much for the *time* the new machine will save in doing his work and for the increased output of his product. Take the one feature—*time saving*—away from any machine and it is nothing but a heap of scrap iron of no purpose nor value whatever. You can reduce the value and purpose of any machine to *time*, and *time* is equivalent to money.

So much for the man who buys the machine. Now about the man who builds the machine. He in almost every case must give an estimate, a certain price for which he will build the machine. This price again is based on the *time* required to make each part of the machine—a difficult problem to solve on account of two reasons: First, if the price is too high his competitors stand behind him with a lower figure, in which case he runs the risk of not getting the job at all; and, second, if the figure is too low he will lose *time*, *i. e.*, money, and that certainly will not do. But sometimes even the price set for the machine will not secure the order, but the *time* in which the order can be filled secures it. If the man who needs the new machine can get it of Mr. A six months earlier than of Mr. B, even though Mr. B's price is lower, he will order of Mr. A because setting this new machine at work six months earlier means to him a great gain of *time*, *i. e.*, money.

Now we have the machine specified and ordered, also the time set in which it must be delivered. The typewritten specifications are handed to the chief draftsman and through him to the designer, but very often between the time the machine was ordered and the time the specifications get to the hands of the designer from two to four months have elapsed, for the simple reason that this *one* machine is not the only pebble on the beach. There are other machines, by the dozen, some of them perhaps overdue, and they had to be taken up first. To hire more help is easier said than done. The numerous ads. in the AMERICAN MACHINIST prove this, and under such circumstances half the time in which the machine was promised to be built is past before the designer gets a smell of the specifications. All at once some nice morning the chief draftsman rushes up and instructs the designer in a polite but hasty manner to turn the job on hand over to another man, as the drawing is far enough advanced to be given to a trustworthy draftsman, "and here," he continues, "I have another machine which is in a great hurry," and, handing over a typewritten specification of twenty pages or so, he rushes off, adding that the machine is due in six months. The designer will soon see by the date of the specifications and other correspondence, that the machine was ordered four months prior to the time he received the specifications, but, as this is the case with nearly every job, he does not mind it.

The first few days are spent partly in memorizing the specifications and partly in figuring, and after two weeks of hard work you can see nothing of that new machine but a lot of figures, a sheet of paper with a few straight lines on it and a chaos

of all sizes of circles, when up comes the chief engineer with a letter that reads like this: "Please send us at once the foundation plan of the machine ordered under No. so-and-so, as the building of our new factory nears completion."

Just think! The designer has nothing to show of the machine, but figures and a few lines and circles. In all haste a foundation plan is fixed up. The necessary dimensions are taken, partly from the specification and partly from the few lines and circles, and the plan is sent away the following day with a letter informing the customer that this plan will give the dimensions of the main foundation only, and a few dimensions over all, in order to locate the machine in the shop, and that he will receive a second corrected foundation plan in the near future—near future in this case meaning from three to four months at least. The designer is now in position to do some actual designing, though of course the time is so short and pressing that he is barely able to give the design due consideration.

About a month before the delivery of the machine the customer will receive the second corrected foundation plan, and finally, after the machine is six months overdue, its delivery is made, the customer congratulating himself that the overdue time is only six months and not nine.

Dear Mr. Editor, after having outlined to you in detail the general modern conditions under which a new machine is designed and then turning again to your suggestion of a "New Phase of Machine Design," I have to smile again, and I can see your face making an effort to join me in my smile.

In conclusion, I will give two instances. The first one will show the absurdity of making a perspective drawing or of paying any attention to the artistic appearance of the machine, and the second case will prove the impossibility of executing a perspective drawing in full size, in order to find any defect in its design:

Ten years ago I was employed by a firm in New York. During my time they had a machine on the floor under test, a most unsightly, ugly-looking affair: a square box of cast iron upon which was mounted what might be called two headstocks. Between them was a rotating disk and inside the box were some cams and levers. On the side two levers stuck out connected by a rod, in the center of which was an adjusting nut about the size you may see on the adjusting rods of the Brooklyn Bridge. In one word, it looked awful, but—and this is where my smile is justified—this machine turned out thousands of pearl buttons per day, nicely finished on both sides, with four little holes drilled into them, ready to be sewed on fancy shirts, etc. This machine made thousands of dollars for its owners. How much do you think that they or anyone else cared for the artistic appearance of the machine?

To-day I am employed by a concern that builds some of the largest machine tools in the country. Two machines are now under construction, one which has a bed length of 100 feet and a length over all of more than 250 feet. The other machine has a vertical saddle travel of 10 feet, making a column hight over all of about 25 feet.

On what would you suggest that a full size perspective view of either of these machines should be made? The most convenient place would be the smooth back wall of a New York sky-scraper. The *function* that a part of a machine has to perform will govern and dictate its design and the closer the designer observes this principle the more pleasing to the eye, the more artistic his machine will appear.

To design machines according to your "New Phase of Machine Design" is indeed a noble thought and, thinking a little deeper over it, gives one an idea of what might be done if "making a living" did not depend on our work, and if the compensation for our work were honor, credit, praise, admiration, instead of the Almighty Dollar.

Hamilton, Ohio. JULIUS KREIS.

[Not all machines are designed in a hurry and some people do care for artistic appearance. In none of the cases mentioned in our article was the perspective drawing full size or anywhere near it. All the same, our correspondent gives a graphic picture of the manner in which a great deal of work is done. He has obviously "been there."—Ed.]

Paper Friction Wheels.

Editor American Machinist:

Perhaps my digestion is improving, perhaps the hot weather has made me too indolent to keep up to my usual standard of contrariness, at any rate I have not troubled you for some time, but I'm at it again now on a new subject. I have been designing some hoists to use with derricks since you last heard from me and I had occasion to look up the records of some which were built years ago and I came across some rather surprising things in my search.

I have one of those "knowledge boxes" invented by Mr. Halsey and described in your columns some years ago,* and in laying out the hoists I turned to this for information on paper and iron friction wheels. The card referred me to articles by Prof. Goss, of Purdue University, in the AMERICAN MACHINIST, at page 1157, Vol. 19, and at page 70, Vol. 20, also to one by Mr. De Wolfe at page 754, current volume. This latter is a very complete affair, but refers to Prof. Goss and seems to quote him as about the most trustworthy authority on a subject regarding which little has been published.

* The Card Index System of Filing Notes and Clippings, page 797, Vol. 21.

Prof. Goss's formula for paper wheels over 8 inches diameter is:

$$\text{H.-P.} = .000238\ D\,W\,N,$$

in which D equals the diameter of the paper wheel in inches, W the width of face, and N the number of rotations per minute. Mr. De Wolfe says this formula rates paper and iron frictions as high as is advisable under average conditions, but that sometimes, under favorable circumstances, as much as 100 per cent. more power has been transmitted.

My surprise came when I applied this formula to a 50-ton derrick hoist which we built eight or nine years ago, having a paper friction 12x12 inches and running 136 revolutions per minute. This hoist lifts maximum load at 5 feet 6 inches per minute, and this would call for an expenditure of 16.6 horse-power, with no allowance for frictional losses, which are generally high in this class of machinery. According to the formula the friction is good for 4.66 horse-power, while it is safe to say it has been delivering 20, probably considerably more than that.

It did not lessen my surprise when, upon inquiry, I found that the original paper friction was not replaced until about a year ago, having given over 7 years of constant service while overloaded to about five times its rated capacity. Of course this derrick did not hoist 50-ton loads every day, but it was often called upon to handle from 30 to 50 tons. The conditions under which this record was made were by no means exceptionally good, being about what might be expected around a stone quarry.

At the bottom of my index card I find a note as follows, and though I cannot say it was from any of Prof. Goss's writings, it was taken from the AMERICAN MACHINIST: "A paper friction wheel may be expected to carry about one-half the power of a single belt of same width and speed." This rates the friction about the same as the formula, $.000238\ D\,W\,N$, and yet we are using a 12-inch *double* belt on 24-inch pulleys to drive a paper friction, 18x12 inches, and we find the friction can slip the belt at that. This seems to disprove the friction formula or the generally accepted belt ratings.

On another machine we have a paper friction wheel, 6½x7 inches, driven by a 1¼-inch manila rope on a grooved sheave 30 inches in diameter, and that has been known to slip the rope on many occasions. Were it not for these instances I should incline to the idea that there was something very unusual in the performance of the 12x12-inch hoist friction, but as Prof. Goss says frictions under 8 inches in diameter do not equal the efficiency of larger ones, I am forced to conclude his formula does not rate spur friction wheels as high as is consistent with good results in service.

In the AMERICAN MACHINIST, at page 274, Vol. 24, there is a short article on

frictions by someone signing himself "Transmission," in which he says he allows 1 horse-power for every 500 feet of surface speed per inch of face. This gives 10.3 horse-power for the 12x12-inch friction at 136 revolutions per minute. "Transmission" lays considerable stress on the way a friction is built up, and this does have a great deal to do with its durability, possibly also its efficiency. He advises one ¾-inch bolt for every 20 square inches of disk.

We are using beveled frictions quite extensively, and these are very nearly as large as would be required by Prof. Goss's formula, but we have never had occasion to try them with the overloads (?) which the spur frictions take care of so easily. They are more constantly in mesh and have to lift their maximum loads oftener. Their average life seems to be from two to three years. We had trouble at first by the thin corner at the large end caving off under the pressure of contact, but we now use a disk of soft wood about ¾ inch thick as the backing for the paper, and this gives fine results.

Now, having told about all I know of paper friction wheels, I hope to fare better than the man who bores pulleys, and who asked for much, yet gave nothing and, up to date, got nothing in return. Tecumseh Swift was perfectly justified in making an example of this pulley borer, for it is quite too common a practice to stand off and demand information without giving the informer any inducement to part with his knowledge or showing him where to start in to advantage in the process of enlightening ignorance. I wonder sometimes how many would have the "cheek" to ask a man to his face for what they take for granted through the columns of a technical paper. E. R. PLAISTED.

The Application of the Metric System.

BY ERNEST R. BRIGGS.

Much—too much—has been written respecting the theoretical pros and cons of the metric system and too little as to its working in every-day use. At the outset it may be mentioned that it is only within the scope of this article to consider the application and working of the system in mechanical engineering.

Of all the great movements of the century that has closed, none is so great and so far reaching in its effects as that of intercourse between nations, and with the ever-increasing facilities of communication and travel this movement will make great strides during the present and coming century. Some fifty years ago the business of a mechanical engineer was largely confined to an almost local trade, and in such cases where he exported machinery it could hardly be described as an international trade. Such a trade, however, we have at present.

It is beyond all question that the use of an American, an English or a Continental standard for certain parts of machinery is attended with great inconvenience, not to say a decided disadvantage; and right here comes the crux of the whole question. Trade is no longer local; it is no longer national, but it is international, and surely none recognize this better than American machine-tool builders. With an international trade it becomes imperative to have an international system of weights and measures. As the needs of trade caused manufacturers to fix standards half a century ago, first for their local and then their national trade, so now the same need is causing the movement towards international standards.

The question therefore arises, how best can this introduction take place—with a minimum amount of inconvenience? In the first place, the change will be gradual; the process will be evolution. Shall a definite term of years be fixed? Does not experience show that if a fixed period is given within which to complete a reform that that period of time is the length of a new lease for the old method? If, say, ten years was fixed, then the introduction of the metric system would be delayed for ten years, because of the natural tendency of human nature to "put off till to-morrow what need not be done to-day." The more satisfactory way to make the start is to have an active propaganda with manufacturers and chambers of commerce, engineering and trade societies. One very good beginning that could be made would be for universities and colleges to *use* it—not dabble in it—but actually use it, and so give the coming brains of the country actual practical experience with it.

Having assumed that the new system will come, let us examine into some of the points that manufacturers have to face. For the sake of example, suppose that it is decided to introduce the system into a large concern manufacturing steam engines, and suppose also that these engines are highly standardized, and have been up to the present manufactured on an inch basis of measurement. All manufacturers who value their businesses keep their standards in a constant state of revision; a week never passes but what some little alteration or improvement is made. It is clearly here a matter of difficulty to effect any change in the unit of measurement in the works. For the present these little improvements continue to be made as before—in the English measurements; but new designs are laid down, larger or other size or different engines are to be made to suit the varying demands of the market, and here we commence with the metric standard right from the drawing. If the draftsman has the interest in the work that he ought to have, he will make all the calculations necessary in kilograms and centimeters, and figure up all his drawings in round millimeters; he never refers to the inch—he thinks in millimeters.

New jigs, gages, dies, etc., are required for the new engines, irrespective of the standard of measurement, and these are of course made in millimeters. There is no difficulty with the workman; he has a scale with millimeters *only* on it, and as the drawings are figured only in millimeters, he must use it, and experience shows that in half an hour he has learned all he need learn.

If the draftsman has done his work well, he has figured all work, required to be worked to with small standard gages, in even millimeters, and a set of such gages is obtained and placed in the toolroom or elsewhere, with the existing standard English gages.

Screw threads are for the present kept the same; even continental firms have not wholly adopted the metric screw threads; large numbers use the Whitworth. If we are content to use wire and plate gages that cannot be expressed under seven places of decimals, why stick at using Whitworth or Sellers threads on metric work. It is worth while noting that electrical engineers largely use the British Association standard threads for small work; and they have no difficulty in using these screws—based on the millimeter—for work based on the inch measurement.

Experience has proved that it is possible to use the metric system side by side with the English system, and that there is no difficulty in even making parts of one standard fit to parts of the other standard, and so gradually, bit by bit, the old series can be withdrawn and none but the metric remain in use. The actual time taken in this transfer period cannot of course be fixed; it depends upon purely local conditions; but the shorter the better.

There will be little difficulties cropping up from time to time during the process of introduction, but these will grow less and less as the work progresses, and manufacturers making complete articles, such as engines, machine tools, etc., need have no fear but what the result will be successful, provided the matter is taken up whole-heartedly.

The actual period that must necessarily elapse before any satisfactory progress can be made with the universal adoption of this system will, and indeed must, depend upon the manufacturers themselves, upon the people who buy and sell in other markets. For beyond all doubt, and notwithstanding all that can be said, the metric system is here, for good or evil, and the metric system is here to stay. Its progress will depend solely upon the manufacturers themselves, and they will move with the requirements of their international trade.

Rugby, England.

A reader would like to know how to filter or otherwise purify gasoline that has been used in cleaning oil and chips from machine parts. Another would like to know how to make polished holes in hard rubber.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 700,000 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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Metric System Testimony.

Elsewhere in this issue we publish a second communication on the metric system from Mr. Briggs, who is connected with the firm of Willans & Robinson, in whose establishment engines are manufactured, some to the English and others to the metric standards. As we remarked on a former occasion, Mr. Briggs therefore speaks from a basis of experience with just the sort of work that will be done during the transition from one system to the other. This article is published in accordance with our policy of giving free opportunity—in fact, seeking for—the expression of views on this question by men who have had actual experience with both systems of measurement in the construction of machinery.

It should be borne in mind, we think, that such men can have no axes to grind. No one is paying them for advocating the metric system. They commend it for no other reason whatever than because experience with it has caused them to believe it to be superior and because they wish to smooth the way to its adoption. In fact, so far as we know, the only people who stand to profit by the introduction of the metric system are the makers of gages, rules and scales, among whom may be found some of the most strenuous opposers of the metric system.

When we asked various men for an expression of views on the metric system for machine-shop use, as we did Messrs. Mix, Libby and others, we had no idea in advance whether their opinions would be favorable or unfavorable, and would have been just as ready to publish their views if they had been unfavorable. It is not our fault if those whom we happen to hear of as having had experience with both systems show a unanimity of opinion in favor of the metric system. We want the views of men who have had the experience qualifying them to judge of the matter and will print adverse views as readily as we will favorable ones. The AMERICAN MACHINIST is not a metric organ, but on the other hand it does not propose to stick its head in the sand and refuse to recognize plain facts as they actually exist.

Proposed Government Supervision of Corporations.

Geo. E. Roberts, Director of the Mint, who is a student of economic problems, thinks that there must be more and closer supervision of corporations by the government and that the arguments in favor of such supervision of manufacturing and other corporations are as strong as those for the supervision of banks. Then he believes that with such supervision the stocks of industrial companies will become the investments of workingmen and other small capitalists in place of the savings banks. He says:

"But if the business field is to be occupied by the great corporations, if it is true that the small independent producer and dealer must give way to them, how are the savings of the people to be invested? Does it not follow that the people who have been small dealers, and the wage-earners who have savings, must become shareholders in the corporations? It is already a grave problem how to invest the savings of the people. The reduction of interest rates by savings banks tells the story. Millions are wasted annually because safe investments are not readily found. It is important to the country that this capital, vast in the aggregate, be utilized, and with the field for independent business by the individual constantly narrowing, investment in industrial corporations would seem to be a natural development, and the one to be encouraged. The large corporations assume in that way an evolutionary function as co-operative institutions. If they are succesfully managed, and the rights of small stockholders are properly protected, they will do more to demonstrate the feasibility of co-operation, and to inaugurate it as a practical solution of the labor question than has ever been done heretofore.

"But if this is to follow, these corporations must be conducted with some regard for the rights of the small stockholder. There must be some restriction of those in control of the properties. Stock jobbery must be suppressed and minorities protected. The individual stockholder is as helpless as a single depositor in a bank, and why do not the same considerations of public policy that suggest supervision of banks suggest similar oversight of all these great corporations whose stock is offered for general investment? The government does not undertake to run the banks, but it does attempt to see that they are honestly conducted, and that certain definite regulations are enforced."

This seems plausible and as though it might be made to work in the general interest, but there is a strong and perhaps a growing sentiment adverse to the principle that is involved in Mr. Roberts' proposition, and it is doubtful if the government will be empowered to regulate more than it now does the affairs of the people. The carrying on of manufacturing operations is not by itself a monopolistic operation, though of course a manufacturer may be also a monopolist and is if, in addition to his manufacturing operations, he controls or participates in the control of a monopoly. But by far the larger part of the manufacturing done in America is done under strictly competitive conditions and in many lines the competition is close and severe.

When it is made certain that the laws do not bestow or permit special advantages to the comparatively few, it will, according to the view of very many, be time enough to see what further or better may be done and there is much to be said in favor of the government confining its attention strictly to its own, *i. e.*, the public business, and leaving to individuals the manage-

ment of their own affairs under the greatest practicable degree of individual liberty and freedom of choice in occupations and investments.

Explosions of Threshing Machines.

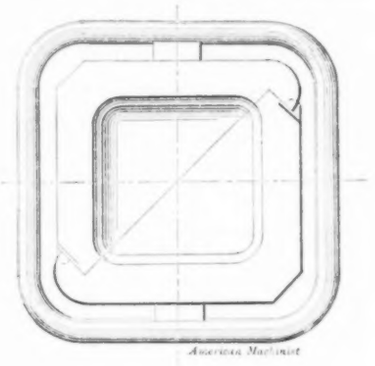
The press dispatches of September 9 relate how so many "threshing machines" have exploded in the State of Washington that something like a "reign of terror" prevails there among the wheat harvesters. At first one's natural inclination is to conclude that boilers of threshing-machine engines are meant, as they are prone to "let go" under the treatment they usually receive, and it is a little difficult to see just how a threshing machine can explode. The dispatches go on to explain, however, that there is this year an unusual amount of smut in the wheat and the dust from this ignites and explodes. Two things are necessary to bring about such an explosion: First, the air must contain a sufficient quantity of very fine dust and then there must be a spark or fire must come into contact with this dust. Dust in the air is not subject to spontaneous combustion. One cannot tell without investigation, but it looks as though the dust theory might have been borrowed from the grist mills and pressed into service to account for explosions which take place as results of neglect of safety valves, steam gages, water gages and crown sheets by men whose cardinal principle in the management of boilers is that "they can't blow up as long as you have plenty of water," and who know no better than to believe that a water glass is always and invariably infallible.

Most of the members of the American Society of Mechanical Engineers know that the committee appointed at Boston for the purpose of formulating a constitution, by-laws, etc., for the Society, has requested that suggestions be sent in by the members. Many suggestions have been received, but we learn that some members who have decided opinions one way or the other as to what should be done hesitate to send them in, fearing that, should these opinions conflict with the ideas or interests of any of the officers or prominent members of the Society, that such officers or members might become prejudiced against the suggestors, to the possible injury of the latter professionally. We cannot sympathize with this view of the case. We do not believe that any officer or prominent member of the Society is so narrow-minded as to allow himself to be influenced personally against a member who may happen to honestly differ from him regarding a matter of policy and concerning the Society's welfare; but if it should happen that there is an officer or prominent member who will allow himself to be influenced in such a way he is a man of too small pattern to be able to exert any influence one way or the other that will amount to much against a man who has in him the elements of a successful professional career.

Some New Things.

PROF. SWEET'S INGOT MOLD.

The cut shows the essential features of an ingot mold recently patented by Prof. John E. Sweet. The mold is made in halves, parting at the corners and both halves precisely alike, so that the joints can be planed or milled continuously in any numbers and all will match each other. In use the halves are held together by



loose rings slipped over and wedges. These molds have usually been tongued and grooved together and parted flatwise, necessitating a different pattern and different planing for each half and not freely releasing the ingot when the mold was opened so that the improvement, both in cost of preparation and in use is evident.

The Outlook for American Machinery in France.

[*By our Special Correspondent.*]

A few weeks ago, when in Marseilles, I wrote you about the prospects for the sale of American machinery in the southern parts of France. Since then I have been pretty well all over the various departments of the Republic. As your readers are chiefly interested in machine tools, I may first mention that France has, for many years, been one of our best customers in that line of machinery, but I fear that our manufacturers will lose ground in the French market, unless they make at once all possible efforts to retain their foothold. I have called upon quite a number of the foremost importers of American machine tools, and all of them agree at least upon one point, viz., that German manufacturers are making the most strenuous efforts to supplant American machinery by machines imitated in Germany. These imitations, as a rule, are good machines, though not as good as the original makes, but—and this goes very far in France—they are a good deal cheaper and can be promptly delivered. Many importers of American tools complained bitterly about our long deliveries, and as a fact I can assure your readers that many French orders have been placed in Germany during the last eighteen months. It is a great pity that the majority of our manufacturers look for foreign markets only when they are short of orders in the States! Herein lies the greatest drawback, and at the same time a danger for the development of our foreign trade. The foreign buyer hates nothing more than to be treated this way. To give you an example: I called upon a well-known machinery dealer in the northern part of France; he had represented a certain American concern for a certain class of wood-working machinery; the gentleman told me that it had taken him nearly two years of hard and systematic work, until he had succeeded in introducing a few machines, but that then orders had come in regularly. Everything went on all right, until one day he was informed by the American manufacturer that "on account of heavy home orders" no export orders could be accepted. He wrote, protested, cabled, told the manufacturer that he had devoted two entire years to the introduction of the machines, but all "en vain." His orders were simply refused. The gentleman could naturally not afford to lose his trade, and he induced French and German manufacturers to build similar machines. I can assure you that this man will never buy a dollar's worth of American machinery again, and, I am sorry to say, he is not the only one who has been treated that way. I have heard the same story all over Spain, Portugal and France.

A few days ago, one of the largest firms in Paris dealing in American machinery complained in the same way. I quote word for word what they said: "We strongly believe that the American tool manufacturers should now pay more attention than ever to their European trade, if they do not want to see it pass into the hands of German manufacturers. One of the most active and intelligent pioneers in the introduction of American tools into Europe was the late Mr. Lucian Sharpe, of the Brown & Sharpe Manufacturing Company, and his principle was to take care of the foreign trade *before* his home trade, being well aware of the fact that the former was the more difficult to secure. He was very much in favor of foreign trade, as it was keeping his shops busy. During the dull periods in the States, in 1892, 1893 and 1894, other manufacturers had nothing or but little to do, while the Brown & Sharpe Company were kept busy with their foreign orders." The gentleman then turned to the question of representation and referred again to the Brown & Sharpe Company, saying that they had divided the European territory in four agencies, viz.: (1) Great Britain and colonies, with agent in London; (2) Central Europe or German-speaking countries (Germany, Austria, Hungary), with agent in Berlin; (3) Eastern Europe (Russia), with agent in Moscow; (4) Western Europe, or Latin countries (France, Belgium, Switzerland, Italy, Spain and Portugal), with agent in Paris.

The Paris firm attends to the business

in France only and has sub-agencies in Belgium, Switzerland, Spain and Portugal. As a matter of fact—and I think I have pointed this out in former letters—a Spaniard is the best man to do business in Spain, a Swiss in Switzerland, an Italian in Italy, and so on. I absolutely believe in this kind of representation. Everybody gives preference to one of his countrymen when placing orders. Though I admit that the Brown & Sharpe's European system of representation is a good one, yet I would in general prefer the following: Great Britain, agent in London and local representation in colonies; Germany, Berlin; Austria-Hungary, Vienna; Italy, Milan; Switzerland, Zurich; Russia, Moscow; Scandinavia, Copenhagen; Spain, Madrid or Barcelona; Portugal, Lisbon; Belgium, Brussels; Holland, Rotterdam.

Again, the European market should by no means be neglected. Our manufacturers should not secure European orders when they need them only, but should keep in close, constant touch with their European agents. The latter should be seen once a year, and together with the agents the manufacturer should call upon the principal users of his machines and tools. This is the way all leading German manufacturers are carrying on their business, and they rather keep their customers at home waiting than lose a foreign order.

Returning to the machinery trade in general, I think that besides machine tools, agricultural machinery and implements, the following list gives a fair idea of what would find the best sale in France: Sawmill and wood-working machinery, barrel-making machinery, special machines for furniture factories, machinery and tools for glass works; clay, cement and stone working machinery; paper mill machinery, shoe-making machinery, machinery used in hat factories, ice-making machinery, knitting machinery, mining machinery (especially rock drills, coal-cutting machinery, etc), conveying machinery, steam pumps, air compressors, electrical machinery, small tools and domestic machinery. Gas and gasoline engines may also be included in this list.

There has been much talk in the United States about reciprocity, and I do not wish to enter into any broad discussion of this important question. I attended the reciprocity convention, held in Washington last year, and I know our manufacturers' pro's and contra's. The AMERICAN MACHINIST has sounded that ground pretty well, and from the opinions of leading manufacturers published some time ago in your columns, one could well observe the fact that the majority of our machinery men are just as much in favor of reciprocity as are the importers of American machinery in France.

Paris, Aug. 30. HENRY L. GEISSEL.

The Requirements of Torpedo Boats.

We clip the following suggestive remarks from a paper by Lieut. Gustav Kaemmerling, U. S. N., which we find in the August number of the *Journal of the American Society of Naval Engineers.* The paper is an account of the contract trial of the torpedo boat "De Long":

"The greatest difficulty this and, I believe, similar boats had to contend with was to make the required speed with a displacement much in excess of that of the original design in accordance with which the boats were powered.

"The cause of this may lie in the overlooking of the real purpose of the torpedo boat in attempting to make them satisfy too many conditions.

"If a torpedo boat makes an attack singly the chances are very much against its escaping, although it may have performed its mission. When an attack is made by a fleet of torpedo boats the chances are that a large percentage of them will be destroyed, although the mission may have been successfully carried out.

"They might be classed as a large dirigible torpedo, to be expended, and that version is generally accepted, I believe, for the crews, in making an attack, are generally considered to have practically no chance for escape from destruction.

"They should be, therefore, constructed with this in view. Torpedo boats have never had a thorough test in warfare, and therefore the theory advanced is admissible.

"The experience at Santiago, where the enemy's destroyers were put out of action so quickly, would tend to show that there is some foundation for the above theory.

"When a boat is designed for 165 tons displacement and powered, accordingly, to produce a fixed speed, it is unfair to the machinery and the scantlings of the boat, which are designed on the lightest possible lines, to produce and endure the strain resulting from the extreme speed in spite of the excessive displacement of 196 tons.

"During the conduct of the various contractors' and official trials I have always felt that the test of a torpedo boat, compared with what it should be, was analogous to running a thoroughbred race horse of the most sensitive organism, carrying cavalryman and full campaign accoutrements, against another race horse carrying a jockey with a pistol only. Then, to carry the analogy further, the service frequently required of it, as compared with that of a cruiser, can be readily likened to loading a race horse with a cavalryman and all campaign accoutrements, with the expectation of having him, so loaded, go through a campaign alongside a regular cavalry mount.

"In the conduct of war the Navy is said to have the advantage of having its commissary department always with it. A great deal of the requirements put upon torpedo boats to make them absolutely independent must eliminate what has generally been considered the first requirement of a torpedo boat, namely, speed.

"It would seem, then, that they should always act from a base, be it a shore station or a ship. Should independent action be required of any boat far removed from a base, such hardships as would ensue from the lack of heavy bath tubs, marble-slab wash basins, various subdivided officers' quarters, all fitted with wood trimmings, a heavy cooking range and other heavy equipments in galley and elsewhere, could be endured, and without unbearable inconvenience under campaign conditions.

"To sum up, a torpedo boat should be constructed to operate from a base, and not be equipped similar to a cruiser.

"If the boats, however, for practice in peace times are to be equipped with all the conveniences of a cruiser, then that condition should be met by not requiring all such unnecessary weights on trial runs and subjecting the boats and machinery to distressing strains on account of attempting to attain great speeds when excessively weighted.

"Having established the boats' capacity for speed with regular war equipment, let them then have placed on board the various fittings necessary to make them comfortable for living quarters, so that they may be used during peace times as practice boats but not as speed record breakers."

Technical Publications.

The publishers of *Moody's Manual of Corporation Securities,* John Moody & Co., 35 Nassau street, New York, have issued a little pamphlet entitled "The 'Morganization' of Industry," which we understand is for gratuitous distribution to those interested and which contains a number of interesting facts and figures.

"The Treatment of Steel." In our notice of this book, published at page 1319, we stated that it was published for free distribution. We are now informed that the Crucible Steel Company of America has reconsidered the matter of price and that they have decided to charge one dollar for it.

"Materials of Machines." By A. W. Smith. 142 5x7¼-inch pages, with 17 illustrations and diagrams. Wiley & Sons, New York. Price, $1.

The many who lack familiarity with the properties of the materials of construction will find this book of genuine value. It contains but five chapters—Outline of the Metallurgy of Iron and Steel; Testing, Stress Strain Diagrams; Cast Iron; Wrought Iron and Steel; and Alloys. In the clearest of language and absolutely without padding, the essential facts pertaining to each chapter are presented. It can be unreservedly recommended.

The machinists employed in the various shops of the Chicago, Milwaukee & St. Paul Railway system find their share of the present good times in a recent advance of wages averaging about 30 cents a day.

There are in Germany 40 works making steel castings, their output in 1901 being 39,000 tons of acid and 66,500 tons of basic steel. The first steel castings are said to have been made in 1843 by Jakob Meyer at the Bochum Works.

A reader would like to have the opinions of men of experience as to the best practice in fitting the pistons of gas engines; particularly with relation to the allowance or difference in size between the piston and cylinder.

The Morgan Construction Company, of Worcester, Mass., contractors, are equipping a box car as a traveling machine shop. The car will contain an engine for power, a lathe, a drill and probably a shaper, with vise bench and a suitable collection of small tools.

According to a press despatch from Washington, the bill establishing a Department of Commerce is practically sure to pass at the coming session of Congress, and it is expected that Mr. Cortelyou, who is at present the secretary of President Roosevelt, will be placed at its head.

Hulse & Co., of Manchester, England, have brought out a planer which has the cross-rail pivoted at one side to a saddle on the face of the upright, and on the other saddle is a segment of a gear, provision being thus made for setting the cross-rail at any desired angle (within limits) to the platen.

It is understood that Pennsylvania Railroad interests and the Vanderbilts have come to an agreement under which their interests in coal mining and hauling, as well as other matters, will be mutually protected and whatever of competition or of working against each other there may have been will cease.

One of the older sayings of Professor Sweet which has almost become a proverb was "Men are paid for what they do and not for what they know." In a circular of the American School of Correspondence we find a companion sentence which deserves to go with it. After saying "your wages are limited by what you can do," it adds "what you can do is limited by what you know." Put the two together and we have an epitome of the path to success—*Men are paid for what they do and not for what they know, but what they can do is limited by what they know.*

Personal.

Will E. D. Becker please send the editor his address?

We noted a short time ago that Mr. F. H. Cathcart had accepted a position as works manager of the C. W. Hunt Company, and stated that he was formerly with Dienelt & Eisenhardt. Mr. Cathcart informs us that he was formerly general superintendent of the Algoma Iron Works of Sault Ste. Marie, Ontario, and that his present position is master mechanic of the C. W. Hunt Company.

Mr. Salomon, who was for some years with the Brown & Sharpe Manufacturing Company, of Providence, and has more latterly been consulting engineer for the firm of Schuchardt & Schütte, Berlin, being their representative in Paris during the Exposition, has, with Mr. Paul Johs. Illing, formed the firm of Franz Salomon & Illing, which will represent various machine manufacturing concerns at 4 Neue Promenade and 9 Prasidentenstrasse, Berlin, C. 22.

Otto Diechmann, who has been in this country for some months, sailed for Germany on the 16th inst., and will establish himself in Berlin. He will be exclusive representative of the Brown & Sharpe Manufacturing Company, the Potter & Johnston Machine Company and the F. E. Reed Company for Germany and Austria-Hungary. Mr. Diechmann has been spending his time in this country in renewing and perfecting his practical acquaintance with American machine tools and in qualifying himself more thoroughly for acting as an expert in matters pertaining to them. In addition to the exclusive representation mentioned above, Mr. Diechmann will have the right to sell the tools of the Detrick & Harvey Machine Company, the Pratt & Whitney Company and O. S. Walker. Mr. Diechmann's address will be Berlin, N. W., No. 7 Postlagernd.

Commercial Review.

NEW YORK, September 15.

The fall trade in the machinery market has opened in a gratifying manner. Machinery houses report the receipt of some good orders during the past week, many of which have been held in abeyance owing to the slight let-up in all manufacturing establishments during the summer season.

Everywhere the belief is expressed that increased activity is among the probabilities of the near future. Perhaps the only tangible reason for this conclusion that can be advanced is the inquiries for machinery that are coming in, which, from a numerical standpoint, are large. From a variety of sources the writer was informed that many of the inquiries indicate that some good orders can be counted upon later on.

The recent advances in lathes, planers, shapers and drills are being well maintained. From a reliable source, however, the information is given that a certain manufacturer of drills is taking orders that are not in conformity with the increased schedule, and that in a certain trade a competitor was forced, rather reluctantly, either to follow in his footsteps or lose an order. He did the former. But, on the whole, and as intimated before, the advanced prices form the basis of nearly all the trades. This statement is significant in view of the fact that when they were made, the opinion prevailed quite largely that they would be more honored in the breach than in the observance.

Concerning the outlook for trade in the machinery market, it is interesting to note that when the summer season was ushered in, not a few orders for machinery were withheld on the belief that they could be placed at cheaper prices in the fall, particularly because the probabilities then, as some people thought, indicated that raw material could be bought cheaper in the fall.

Those who entertained hopes of this character have had them blasted by two subsequent developments. The first was the concerted increase in the price of planers, lathes, drills and shapers, followed by pro-rata increases in almost every kind of machinery, and the second was the increases that have taken place in raw material.

The former has been fully considered in these columns, but the situation in raw material has reached a point where it bears a potent relation to the price of the finished product for some time to come.

At the present time domestic iron is as scarce as the proverbial hens' teeth. Where any is found it is seized with avidity, and at prices averaging from $25 to $28 per ton, according to quantity, grade and destination. Even at these figures American foundrymen cannot get enough to meet their requirements for this year, and are forced to purchase English and Scotch irons at prices averaging from $20.50 to $25 per ton for delivery at seaboard ports, where, it is estimated, according to one authority, iron is coming in at the rate of 2,000 tons per day.

This is the situation, so far as this year's supply of raw material is concerned. When we consider that for next year we find that Southern furnaces have already sold nearly all the iron they are capable of producing for the first six months of 1903. Some idea of the demand made for their product for the first six months of 1903 may be gained when it is stated that the big interests opened their books on the basis of $17 per ton at Birmingham for No. 2 foundry, and requests came in so frequently that they announced their retirement from the market several weeks ago, so far as the first six months of next year is concerned. The latest information from Birmingham is that No. 2 foundry is selling at about $20 per ton, which, with freightage included, makes the price about $24 per ton if delivered in New York.

Northern furnaces are reluctant to take any orders for iron for 1903 delivery. The strike in the anthracite region has played havoc with them, and many furnaces are banked in consequence of

inability to procure coke. Because of this, Northern interests do not know when they will be able to fill orders now on their books, and until they know where they stand in this matter are either unwilling to book any for 1903, or if they do consent to do so, it is along extremely conservative lines and at prices averaging from $21.50 to $23 per ton at the furnace.

From what has been said it is evident that, so far as domestic irons are concerned, no decrease in price can be looked for before July, 1903. Whether the supply of foreign iron that will be available in the meantime will have any effect in forcing down prices is a matter of conjecture. At present the fact is undeniable that the foreign producer can outsell his American competitor, although foundrymen claim his product is not as good.

Because of the statements made, it would seem that those who are holding aloof from purchasing machinery in the belief that a decline in the price of raw material can be expected, and their orders placed on a better basis in consequence, are likely to be disappointed for some time to come.

At no time in the history of the country have the railroads been doing a more prosperous business than at present. The volume of traffic is so enormous that many of the companies have found their equipment inadequate to meet it. As a result they have been forced to add to it, and locomotive builders have all the orders they can fill for a year hence. Because of this fact, Vice-President McCrea of the Pennsylvania Railroad is authority for the statement that the railroads will find it difficult to handle their freight business for this year, in which the transportation of the crops forms a considerable item. Recently the Pennsylvania company decided to purchase 300 locomotives for next year's supply, and there is some question about its ability to get them. The Baldwin and American locomotive works will probably build the majority of them. Many of the railroads contemplate enlarging their repair shops, and machine-tool builders are awaiting definite information in the matter with great interest.

S. N. D. North, chief statistician of the Government Bureau of Statistics, discussing the results of the twelfth census, says that it demonstrates that machinery has been a notable factor in our industrial progress. "To the much more general use of power-driven machinery in this country," he says, "may safely be attributed the remarkable advance of the United States to the first rank among the manufacturing nations. The late Michael G. Mulhall, the English statistician, states that (in 1896) 'nearly all American manufactures are produced by machinery, while in Europe more than one-half is still handwork'; and this is his explanation of the fact he concedes, that the United States, although the last of the manufacturing nations to enter upon the factory system of production, and holding the fourth rank in production in 1860, being then surpassed by Great Britain, France, and Germany, in the order named, has now jumped to the first place, Germany having also passed France in the interval. If we can accept Mr. Mulhall's basis for estimating the value of the manufactures of the United Kingdom, they reached a total of $5,400,000,000 in 1900, which was nearly $3,000,000,000 less than the net value of the manufactured products of the United States as shown by the twelfth census."

The comedy of errors in connection with the bids for the erection of a complete pumping plant at Baldwin's, L. I., received additional emphasis on September 11, when the Greater New York water authorities opened the bids for the fourth time. For the pumping engine three bids were received. Henry R. Worthington submitted two, one for $51,000 and the other for $59,000. The remaining bidder was the Snow Steam Pump Company, whose bid was for $50,000. For the two boilers there were three bids as follows: Jas. Reilly Repair & Supply Company, $12,276; Edward Burhorn, $11,400, and J. Edward Ogden Company, $11,800. It is interesting to note that A. D. Granger & Co., who were the lowest bidders for the boiler equipment the third time the proposals were advertised, did not accept the invitation to bid for the fourth time. Marshall T. Davidson, of Brooklyn, N. Y., who was the lowest bidder for the pumping engine last August, entered a protest, through counsel, against the contract being awarded to anyone but him. As matters stand now, the courts will probably be called upon to adjust the differences, in which case it will be interesting to ascertain the real reasons why a great municipality like New York is compelled to advertise for bids four times, and then have objections made to awarding the contract.

The Union Steel Company, of Pittsburgh, Pa., will adopt electrical power distribution for its new mills. The power will be generated by steam from the waste gases from the blast furnaces, and will be distributed in the form of alternating current to rotary converters at the mills, where it will be used largely as direct current. The Union Steel Company has recently purchased from the Westinghouse Electric & Manufacturing Company two 800-kilowatt alternating current generators, one 800-kilowatt direct current generator, and five rotary converters.

The Navy Department has awarded contracts for the supply of steel material to be used in the construction of the new battleship "Connecticut" at the New York Navy Yard as follows:

Class 1—Ship plates, the Carnegie Steel Company, $179,007.

Class 2—Nickel steel plates, Carnegie Steel Company, $158,077.

Class 3—Steel shapes, Carnegie Steel Company, $78,489.

Class 4—Steel castings, United States Steel Company, $27,763.

Class 5—Hull rivets (plain), American Iron & Steel Manufacturing Company, $19,353.

In each case the award was made to the lowest bidder.

The Pennsylvania Salt Manufacturing Company, of Wyandotte, Mich., has recently purchased a number of direct current motors from the Westinghouse Electric & Manufacturing Company for installation in its plant at Wyandotte.

Contracts were awarded during the week for the machinery to be installed in the new power-house of the Woonsocket Electric Machine and Power Company at Woonsocket, R. I. Westinghouse, Church, Kerr & Co. will furnish the two 750-horse power engines; Babcock & Wilcox the 264-horse-power water-tube boilers, and Thayer & Co. the steam boilers.

The India Rubber & Gutta Percha Insulating Company, of Yonkers, N. Y., is installing alternating current motors to replace a number of small isolated steam engines formerly used for driving the carpenter shops and the winding and braiding departments. A recent purchase from the Westinghouse Electric & Manufacturing Company includes motors of the following sizes: One horse-power, 5 horse-power, 10 horse-power and 15 horse-power.

Bids were opened on September 9 for supplies of machinery for installation in the Navy Yard at Puget Sound. Although many Eastern concerns were among the bidders Western houses were largely represented. The lowest bidders were as follows:

3. Herron, Rickard & McCombe, San Francisco, Cal.
5. American Woodworking Machinery Company, 137 Liberty street, New York city.
9. Pacific Tool & Supply Company, San Francisco, Cal.
19. Drew Machinery Agency, Manchester, N. H.
20. The Robins & Meyers Company, Springfield, O.
21. McCay Engineering Company, Baltimore, Md.
25. J. Hendy Machine Works, San Francisco, Cal.
31. Thresher Electric Co., Dayton, O.
35. Ransom Manufacturing Company, Oshkosh, Wis.
41. Hollidie-Henshaw-Bulkley Company, Seattle, Wash.
42. Henshaw-Bulkley & Co., San Francisco, Cal.
43. Williams, White & Co., Moline, Ill.
45. J. Clark, Jr., & Co., Louisville, Ky.
47. J. Martin & Co., 31 New Montgomery street, San Francisco, Cal.

Class 1. One two-frame dimension, plain—Bidder 42, $2,075, $1,935 and $1,875.

Class 2. One heavy double surfacer—Bidder 5, $1,828.76; 42, nine pieces from $1,460 to $1,873.

Class 3. Two pony or panel planers—Bidder 3, $924.

Class 4. One planing and joining machine—Bidder 5, $484.39.

Class 5. One four-sided molding machine—Bidder 5, $695.70.

Class 6. One two-spindle upright molding machine—Bidder 3, $441.

Class 7. One panel raiser—Bidder 3, $395.

Class 8. One wood turning lathe—Bidder 3, $98.

Class 9. One power feed rod machine—Bidder 5, $465.31.

Class 10. One automatic self-feeding circular riping saw—Bidder 5, $814.15.

Class 11. One railway automatic circular cutting-off saw—Bidder 3, $752.

Class 12. One swing cutting-off saw—Bidder 3, $661.50.

Class 13. One 60-inch hand resawing machine—Bidder 42, $2,055.
Class 14. One 42-inch scroll band sawing machine—Bidder 42, eight prices from $578 to $813.
Class 15. One scroll saw—Bidder 42, $308 and $330.
Class 16. One automatic hand stile mortiser and border—Bidder 3, $484.
Class 17. One combined vertical and horizontal boring machine—Bidder 3, $444.
Class 18. One box joint machine—Bidder 3, $751.
Class 19. One wood trimmer and stand—Bidder 41, $135.60 and $178.40.
Class 20. Two bench wood trimmers—Bidder 5, $40.
Class 21. One automatic combination sharpener for circular and band saws—Bidder 41, $113.25.
Class 22. One hand sharpener and gummer—Bidder 5, $45.85.
Class 23. One automatic planer knife grinder—Bidder 42, $325 and $340.
Class 24. One metal band saw for brass—Bidder 3, $189.
Class 25. Three 12-inch sensitive drills—Bidder 41, $300.
Class 26. One 13-inch monitor lathe for brass—Bidder 19, $683.75 and $732.28.
Class 27. Two 22-inch upright drill presses—Bidder 41, $430, $480 and $720.
Class 28. One buffing lathe—Bidder 35, $68.
Class 29. One double dry plain and surface grinder—Bidder 9, $65.
Class 30. One grinder with belt strapping attachment—Bidder 35, $70.
Class 31. One twist drill grinder—Bidder 41, $69.40.
Class 33. One plain double dry grinder—Bidder 47, $260 and $485.
Class 34. One universal milling machine—Bidder 16, $1,075.
Class 35. One hydrostatic wheel press—Bidder 25, $1,940.
Class 37. One monitor lathe—Bidder 9, $560.
Class 38. One toolroom lathe—Bidder 41, $467.50.
Class 39. One screw cutting lathe—Bidder 41, $585.
Class 40. One 1½-inch double bolt cutter—Bidder 41, $656.65.
Class 41. One 1½-inch single bolt cutter—Bidder 41, $344.50.
Class 42. One metal cold saw cutting-off machine—Bidder 41, $1,550.
Class 43. One post drill, motor driven—Bidder 3, $546.
Class 44. One horizontal drilling and tapping machine—Bidder 41, $485 and $385.
Class 45. One heavy double punch and shear—Bidder 43, $5,840 and $5,955.
Class 46. One 600-pound single frame steam hammer—Bidder 9, $755.
Class 51. One 15 horse-power vertical motor—Bidder 31, $375.
Class 52. Two 15 horse-power motors—Bidder 45, $744.
Class 53. One 15 horse-power motor—Bidder 45, $412.
Class 54. One 12 horse-power motor—Bidder 45, $372.
Class 55. One 10 horse-power motor—Bidder 45, $314.
Class 56. One 10 horse-power motor—Bidder 21, $410.
Class 57. One 10 horse-power motor—Bidder 20, $355.30.
Class 58. One 6 horse-power motor—Bidder 21, $235.
Class 59. One 6 horse-power motor—Bidder 21, $310.
Class 60. One 5 horse-power motor—Bidder 21, $240.
Class 61. One 5 horse-power motor—Bidder 21, $240.
Class 62. One 5 horse-power motor—Bidder 45, $244.
Class 63. One 5 horse-power motor—Bidder 21, $260.
Class 64. One 3 horse-power motor—Bidder 45, $154.
Class 65. One 3 horse-power motor—Bidder 45, $154.
Class 66. One 3 horse-power motor—Bidder 45, $154.
Class 67. One 3 horse-power motor—Bidder 45, $154.
Class 68. One 2 horse-power motor—Bidder 45, $154.

CHICAGO MACHINERY MARKET.

Current business in electrical equipment is going to those makers who can make the better deliveries, and some manufacturers' agents here say that choice contracts have to be passed by for this reason. On big work deliveries have been promised in some instances within forty-five days; other producers are asking from five to seven months for large units and from sixty to ninety days for the smaller jobs. They are not getting the business where their chances otherwise are favorable. There is no one in the electrical machinery trade here who does not speak in the most respectful terms about business, even those who have not been booking so many orders as they would wish. One representative says his trade during the past month has been light, but through a combination of unfortunate circumstances three large orders which were all but closed were deferred until next year, because the proposed buyers were unable to obtain expected deliveries on some material.

The activity in the electrical trade extends to all the branches. There is a large amount of street railway work in sight. One of the largest contracts is that of the Union Traction Company of Indiana, which is in the market for generators, cars and other purchases, aggregating in value, according to the estimate of one manufacturer's representative, $200,000. The Twin City Electric Company, of Minneapolis, is asking for equipment valued at almost half that amount. No less active is the inquiry for equipment from factories. One seller says 5 per cent. of the machine tools are not yet operated electrically. At Chicago recently four large manufacturing companies have appointed electrical engineers to take up the question of equipping their shops. One of the largest contracts recently placed is that of the Penn American Plate Glass Company, Alexandria, Ind., which has placed an order for four 400-kilowatt engine-type generators, seventeen 100 horse-power motors, four 125 horse-power and two 200 horse-power motors to operate the grinders only, this being about half the equipment to be ultimately installed. The Farwell Portland Cement Company, Farwell, Mich., will equip electrically. The Lima Locomotive Works, Lima, Ohio, have addded 100 horse-power in motors; Omaha Packing Company, Omaha, 150 horse-power in motors; Vilter Manufacturing Company, Milwaukee, will equip electrically; the Standard Blue Flame Oil Stove Company is building at Kankakee, Ill., a plant to be equipped electrically; the Ohio Brass Company, Mansfield, Ohio, has placed an order for a 200-kilowatt engine-type generator and 300 horse-power in motors; William Todd Company, Youngstown, Ohio, has added several hundred horse-power in motors. The Sprague Electric Company has sold 75 horse-power motors to the Springfield (O.) Metallic Casket Company; an electric equipment to the Record Printing & Box Company, Grand Rapids, Mich.; 270 horse-power motors to the Automatic Electric Company., Chicago. The Akron Electric Manufacturing Company has sold a 100-kilowatt generator and 50 horse-power motors for the C. C. Heisen factory, Chicago. The Crocker-Wheeler Company has sold 150 horse-power in motors to the Minneapolis Steel & Machinery Company; 55 horse-power motors to the Lake Shore road; one 400-kilowatt generator to the Chicago Great Western road; 65-kilowatt generator to Wickes Bros., Saginaw, Mich.; 75 horse-power motors to the Link Belt Machine Company; 30 horse-power motors to the American Machinery Company, Grand Rapids, Mich.

Quotations.

NEW YORK, Monday, September 15.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:	
No. 1 X	$23 50 @ $25 00
No. 2 X	22 75 @ 23 50
No. 2 plain	22 25 @ 22 50
Southern:	
No. 1 Foundry	22 00 @ 23 00
No. 2 Foundry	21 75 @ 22 50
No. 3 Foundry	21 25 @ 22 75
No. 4 Foundry	20 25 @ 21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅞ @ 12⅛c.; electrolytic and casting, 11¾ @ 11⅞c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 26⅜ @ 26¾c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5⅝c.

Antimony—Cookson's, 10¼c.; Hallett's and U. S., 7¾ @ 8c.

Lard Oil—Prime City, 79 @ 81c., according to brand and quantity ranging from one barrel up to large lots.

Manufacturers.

The Hudson (Mass.) Worsted Company will enlarge its plant.

The Sun Stove Company, Detroit, Mich., will build an addition.

The Novelty Glass Works, Washington, Pa., will be greatly enlarged.

The plant of the Utica (N. Y.) Excelsior Company has been burned.

The Bell Pottery Company, Findlay, O., is to build works at Columbus.

The Elgin (Pa.) Chair Company will build an annex to its factory soon.

The Detroit (Mich.) Steel Casting Company has had plans made for an addition.

Martin Heinicke, of Springfield, Ill., is building a factory to make a stacker of his invention.

The Detroit Automatic Stoker Company, Detroit, Mich., is planning to build a new plant there.

The Vulcan Iron Works, New Britain, Conn., will shortly put in a new boiler and engine.

The plant of the Delphi (Ind.) Lumber

Company has been destroyed by fire. It will be rebuilt.

A plant at Cartaret, N. J., of the International Phosphate Company, of New York, has been burned.

The Elm Mill Woolen Company, Tilton, N. H., will add more looms and make another weave room.

The sawmill plant of Greemann Bros., Batesville, Ind., has been burned. It will be at once rebuilt.

The Crenshaw Oil Company has been incorporated and will build a cotton oil mill at Crenshaw, Miss.

John M. Fleming, late of the Sharon (Pa.) Boiler Works, has a project to build a new boiler works there.

Work is progressing on an addition to the plant of the Malleable Iron Fittings Company, Branford, Conn.

A power plant is to be built for the Lehigh Valley Traction Company, at Allentown, Pa. It will be 118x169 feet.

The Harrah & Stewart Manufacturing Company, Des Moines, Ia., manufacturer of rubber tires, etc., is to build.

Work has begun on a new building for the Calcasieu Iron Works & Mill Supply Company, Limited, Lake Charles, La.

The Rapid Transit Company, running between Des Moines and Waterloo, Ia., will build car shops at the latter place.

Charles Chambers, of West Grove, Pa., has purchased property at Green Castle and will convert the building into a silk mill.

A 150-ton capacity oil mill is to be built in East St. Louis, Ill. M. E. Singleton, of Fort Worth, Tex., will be general manager.

The Southern Engine & Boiler Works, Jackson, Tenn., has shipped over $30,000 worth of machinery in about thirty days past.

E. T. Heineman, Cincinnati, O., has bought a site for a brewery and has organized the Highland Brewing Company to build it.

A 50-foot extension will be built to a plant of the Tioga Foundry Company, which is to be addressed, we believe, in Philadelphia.

The Walter M. Lowney Company, of Boston, Mass., chocolate manufacturer, has bought land for a large plant in Mansfield.

The R. Herschel Manufacturing Company, Peoria, Ill., mower knives, etc., is about to erect a plant, to be located at East Peoria.

A factory building, 100x200 feet, two stories, is about to be erected for the National Wire Corporation, New Haven, Conn.

An addition is being built to the foundry of the Eynon-Evans Manufacturing Company, engineers and machinists, Philadelphia, Pa.

F. K. Stevens will build a $25,000 manufacturing plant at Chicago Heights, Ill., to be one and two story, 274x150 feet.

Plans for a new factory, 80x100 feet, have been prepared for the Keystone Manufacturing Company, Buffalo, N. Y., maker of metal tools.

The Borough & Blood Carriage Company, of Marshall, Mich., has been incorporated and will build a factory there to employ 100 hands.

A concern described as the American Actinolite & Asbestite Company, New York, proposes to develop mineral lands in Canada and to erect a plant.

The works of McKenzie & Diamond, boilermakers, Elwood, Ind., will be enlarged by new buildings and machinery. A stock company is being formed.

J. W. Seaman, of Shulie, Cumberland County, Nova Scotia, and others, have leased timber areas, and mills will be built to begin sawing this winter.

We understand that the Continental Paper Bag Company, New York city, proposes to enlarge its mill at Rumford Falls, Me., by a 500-foot, five-story addition.

The Lincoln (N. J.) Steel Works Company has commenced hauling brick for an addition to its plant. The plans call for a structure 300 feet long, two stories high.

Deeds for the property purchased by the United States Steel Corporation in McKeesport, to be the site for the new $10,000,000 tube plant, have been delivered.

William Steele & Sons, Philadelphia, have been taking sub-estimates on a machine shop, 265x60 feet, containing crane runways, to be built at the Altoona shops of the Pennsylvania Railroad.

The Downie & Wright Manufacturing Company, of York, Neb., founders, has purchased land adjoining its property which will afford an opportunity to expand the plant as business demands.

The concentration building of the Montana Ore Purchasing Company, at Meaderville, near Butte, Mont., has been destroyed by fire with a 325 horse-power dynamo and other machinery.

The Crescent City Trunk Company, Ltd., has been formed to take over the factory and business of the Crescent Trunk Company, at 933 Gravier street, New Orleans, La., and build a large new plant.

It is reported in Chicago that Frommann & Jebsen have made plans for a $50,000 machine shop to be built in Maywood for the "American Tin Can Company." It will be three-story, 97x297 feet.

The Lamb Manufacturing Company, of South Sioux City, Neb., has increased its capital stock from $50,000 to $150,000, and is about to build an addition to its plant for the manufacture of malleable iron castings.

The plant of the Ohio Machine Tool Company, Kenton, O., burned September 4; reported loss, $100,000. Sixty men are thrown out of employment. The machinery for an addition employing 100 men had just arrived.

Fire, September 6, did considerable damage to the plant of the Hartford (Conn.) Foundry Company, but it was hoped to have 60 per cent. of the plant in operation again inside of ten days and the remainder as soon as possible.

A fire has occurred in the works of the United Boxboard & Paper Company, until recently the Bogota Paper Company, between Bogota and Ridgefield Park, N. J. The flames ravaged the machinery shed, but were stopped at the main building.

The Park City Manufacturing Company, of Chicago, Manufacturer of "D. & J." bicycle crank hangers, informs us that the statement we published on page 1241, that it would remove its plant to Webster City, Ia., next season, is false, and we hasten to correct it.

Another manufactory is talked of on the part of employees of the Kelly & Jones Company, Greensburg, Pa. It is said they propose putting in $500 each and organizing a cooperative company for the manufacture of valves, fittings, etc.

S. B. Steece, president of the Ironton Portland Cement Company, which is soon to start up a $200,000 plant just east of Ironton, O., has bought land elsewhere on which it is proposed by him and associates to erect a Portland cement plant next year.

J. W. Forster, of Lincoln, Ill., has secured a patent on an incandescent electric light bulb, and a factory will be built in Lincoln for its manufacture. The Forster company has already been organized with $250,000 capital. Work will soon begin on the factory.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Will build light machinery or specialty. Box 232, Clifton, Pa.

Will pay 25c. each for copies September 26, 1901. Dodge & Day, Philadelphia.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Machine for wax plate making wanted. Address Blue Island Specialty Co., Blue Island, Ill.

Book, "Dies and Diemaking," 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Light and medium machinery built to order; estimates furnished on all kinds of machine work. F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears, catalog of small tools free. R. M. Clough, Tolland, Ct.

Drafting, by the job or hour; contracts made for regular work; ideas perfected; all mechanical drawing done quickly and accurately. B. & K., care AMERICAN MACHINIST.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R.; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Draftsman, mechanical and electrical, wishes position. Box 887, AMERICAN MACHINIST.

Competent draftsman desires position; New York or vicinity. Box 849, AMER. MACH.

Experienced machine shop foreman open to receive offers; references. Box 861, AM. M.

Draftsman, electrical engineer, wants position; electrical line preferred. Box 893, A. M.

Designing draftsman, 7 years' shop and office experience, wants position. Box 889, A. M.

For help, write The New York Engineering Agency, 35 Warren st., N. Y. No charge to employer.

Mechanical draftsman, technical graduate, 27 years of age, 6 years' experience. Box 892, AMERICAN MACHINIST.

German, 24, graduate of 1902, speaking perfect English, some experience, seeks position. Box 886, AMERICAN MACHINIST.

Draftsman, 4 years' experience on machine tools and special machinery, technical education, will go out of city. Box 867, AM. M.

Position as foreman, by specialist; milling

and gear cutting; 15 years as foreman; A1 recommendations. Box 870, AMER. MACH.

Draftsman, marine engineer, technical graduate from German high school, good experience on first-class work, wants position. Box 868, AMERICAN MACHINIST.

Foreman on small or medium work, by up-to-date man; desires to make a change; understands milling and gear cutting thoroughly. Box 872, AMERICAN MACHINIST.

Wanted—Position as superintendent or foreman of iron foundry; practical and successful; accustomed to estimating, etc. Address R. H., care AMERICAN MACHINIST.

Superintendent of small shop, successful in handling men, experienced designer machine tools and special machinery, open for engagement. Address Box 885, AMER. MACHINIST.

Position wanted by first-class machinist to keep in repair machinery for manufacturing concern; can furnish machine tools; Southwest or Pacific coast preferred. Box 882, A. M.

Experienced machine designer, practical, thorough, original, 10 years on automatic machinery, graduate, wants position of responsibility in or out of drafting room. Box 817, AMERICAN MACHINIST.

Position wanted to take charge of small shop employing from 10 to 40 men; can make working drawings; prefer Philadelphia or vicinity; best recommendations. Box 871, AMERICAN MACHINIST.

Wanted—Position as inventor, or experimental work; I am a first-class toolmaker, brass finisher and electrical machinist and can give the best of references. Address Box 894, AMERICAN MACHINIST.

Position—3 years' shop experience, 9 designing machine tools and light automatic machinery, 3 charge of manufacture of interchangeable work; present location New York city. Box 880, AMERICAN MACHINIST.

Would like to hear from parties needing first-class designer of light machinery and fixtures; experience in adding, type-setting, typewriter, paper-working machines; able to take charge. Box 879, AMERICAN MACHINIST.

Young man, technical graduate, practical mechanic, wants position in South American countries with reliable firm; Spanish and Italian spoken; references as to character and abilities. Box 881, AMERICAN MACHINIST.

Wanted—A responsible position, by a man with technical education and 17 years' practical experience, chief draftsman, machine shop foreman, erecting engineer, inspector and assistant general manager. Address Box R, care AMERICAN MACHINIST.

Superintendent or general foreman, by thoroughly practical machinist; large experience in handling work and men; good shop organizer, manager and executive; best of reference; position with first-class, progressive firm desired. Box 873, AMER. MACH.

A mechanical engineer, with long experience as machinery builder, desires to connect with a well-established machine works; can introduce profitable line of machinery; managing position only considered, with or without investment. Box 884, AMERICAN MACHINIST.

First-class mechanic, with 10 years' shop experience, 3 years chief engineer on sugar estate in tropics, also spent some time in drafting room, capable of looking after and taking care of machinery and handling men, wants position. Address F. W. B., care A. M.

General foreman or foreman of machine shop; good, systematic manager, A1 mechanic and a hustler; experienced on special machinery, repair and electrical work, both medium and large; age 28; references on request. Address Box 869, AMER. MACHINIST.

Mechanical engineer, 24 years, energetic, ambitious, technical graduate, 5 years' shop and drawing-room experience, good constructor and draftsman, desires to make a change for December 1, or before, and is looking for a good position, with chances of advancement, with concern near or in New York city. Offers under Box 891, AMERICAN MACHINIST.

Managing engineer and commercial man, corporation business over million yearly, desires change; have excellent executive ability; wide experience; familiar with shop order systems and cost accounts; great head for following up detail; expert designer; a pusher; can keep peace among employees; correspondence solicited. Box 854, AMER. MACH.

Mechanical engineer, technical graduate, chief draftsman and expert designer, desires change; 8 years' experience as M. E., assistant M. E., superintendent and chief draftsman, in shop management, power transmission, power plant installation and the design of light, heavy and automatic machinery; best of references. Address Box 878, AM. MACH.

Situation as superintendent wanted by young man, a designer and developer of best class of light and heavy machinery; an expert of highest abilities, as results snow; will accept only a well-paid situation and will assume mechanical or business responsibilities to any extent offered, as he is accustomed to such; 10 years in present position. Box 876, AMERICAN MACHINIST.

Wanted—Position as superintendent or general foreman, by energetic young man, having wide experience in general machine and tool work; thoroughly up to date on interchangeable work; a good executive and a hustler; a progressive concern, seeking to attain the maximum in economy and quality of product, will do well to correspond with me. "American," Box 883, AMERICAN MACHINIST.

Help Wanted.

Wanted—Patternmakers. Apply at National Meter Co., 42d st. and 1st ave., Brooklyn, N. Y.

Mechanical and structural draftsmen; experienced technical graduates preferred. Box 71, Station B, Cleveland, Ohio.

For positions, send stamp to The New York Engineering Agency, 35 Warren st., N. Y., for registration blank. Rates to machinists.

Wanted—One competent foreman to take charge of chain-making plant running about eight fires. Address C. C. McC., care AM. M.

Machinists, send for free blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—Mechanical draftsman for gas engine work; state experience, salary and references. Western Gas Engine Company, Mishawaka, Ind.

Wanted—First-class patternmakers, molders and machinists; good wages and steady employment. Address Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wood pattern maker for malleable and gray iron foundry in Western city; state age and experience and name of former employer. Box 843, AMERICAN MACHINIST.

Wanted—General foreman for night force in large electrical plant; location Middle West; must have wide experience and ability. Box 864, AMERICAN MACHINIST.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—Young man, about 30 years of age, practical mechanic with some ability as salesman, to travel as machine tool demonstrator. Box 822, AMERICAN MACHINIST.

Wanted—Two competent men to erect gas engines, compressors and ice machines in shop or outside as required; steady work at good wages. The Brown-Cochran Co., Lorain, O.

Wanted—Mechanical draftsman, patternmaker and toolmaker; new shop; 60 hours per week; state experience, age and wages. Columbus Iron Works Co., Columbus, Ga.

Wanted—Three patternmakers, accustomed to engine work; six machinists; best wages and steady work guaranteed; references required. Apply Box 875, AMER. MACHINIST.

Wanted—Superintendent for concern manufacturing electric hoisting machinery; thorough knowledge of business necessary; state experience and salary. Box 863, AM. MACH.

Wanted—Patternmaker on wood patterns for machinery, competent to act as head patternmaker and foreman; permanent position to right party. Box 888, AMER. MACHINIST.

Mechanical draftsman and designer with experience in machine tool work, also practical shop experience; state age, experience and salary desired. Bignall & Keeler Mfg. Co., Edwardsville, Ill.

Wanted—Thoroughly competent foreman in modern machine shop, manufacturing steam specialties; give full details of experience, age and wages expected. Address P. O. Box 187, Newark, N. J.

First-class lathe hand to take charge of department (about 20 hands); must be experienced and successful in handling help; for shop in western New York. Address, giving particulars, Box 866, AMER. MACHINIST.

Mechanical engineer to assist in superintending in producing piece work etc.; energetic young man with practical experience. Address, with particulars, stating salary, Niagara Machine & Tool Works, Buffalo, N. Y.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Swedish-American Foremen.—Wanted—Several first-class Swedish-speaking machine shop foremen, well up to date in modern shop practice; apply in Swedish, stating age, experience and wages expected. Address Aktiebolaget Separator, Stockholm, Sweden.

Wanted—Several first-class machinists; both machine hands and floor men; good wages; New England men or Pennsylvania men preferred; state experience and terms or no notice will be taken of replies; strictly confidential. Address Box 890, AMER. MACH.

Wanted—Experienced mechanical draftsman for position with a large manufacturing company located in Pennsylvania; applicants should state experience, age, salary expected and furnish reference; good position for the right man. Box 859, AMERICAN MACHINIST.

Wanted—A foundry foreman; must be used to a great variety of work in green, dry sand and loam; must be intelligent and steady, able to mix metals and handle men; the right man would find this a steady and attractive opening; references required. Apply Box 874, AMERICAN MACHINIST.

Wanted—An all-around machinist, to keep in repair the machinery of a manufacturing plant; must be able to make small tools, do ordinary pattern work, run lathe, planer and drill; a steady position for the right man; send references, stating how long employed and what wages received. Box 803, AM. M.

Wanted—A first-class draftsman and designer of experience, who has also had actual shop practice and is capable of acting as superintendent or assistant manager of a plant building automatic machinery and working about 85 men. Address, stating age, experience and salary wanted, to "N.," care AMERICAN MACHINIST.

Wanted—Two or three good boilermakers and sheet iron workers, to make tanks, smokestacks, blast pipes, coal chutes and general work in this line; steady work and good wages in a first-class, modern shop in Western Pennsylvania, will be given to the right man. Address, stating age and experience, Box 877, AMERICAN MACHINIST.

Wanted—A man to act as Eastern representative for a concern building medium and heavy machine tools; must be a pusher and well acquainted with the Eastern trade; none need apply who are unable to furnish A1 references as to ability and character; New York will be headquarters; preference will be given a practical man with technical training. Address Box 857, AMERICAN MACHINIST. State age, experience, by whom employed, etc.

Wanted—In the publication department of a large machinery manufacturing concern in New England, a young man to prepare all literary matter, edit a monthly engineering magazine, supervise all illustrative work and conduct the advertising; must be technically trained, a master of good English and experienced in the work above outlined; a permanent, growing position for the right man; state experience, submit samples of work and specify salary expected. Box 865, AM. M.

Sales representatives wanted; a large, successful and well established machinery manufacturing company, west of Ohio, doing a constantly increasing business and having an enviable reputation with its present product is prepared to place upon the market a line of electrical machinery, including alternating current generators up to 1,000 K. W. and direct current generators and motors of corresponding size; only high-grade sales representatives are wanted to sell on commission or otherwise; correspondence is desired with established firms or others who are properly equipped and are experienced in the sale of electrical machinery; all communications will be considered confidential. Address X. Y. Z., AMERICAN MACHINIST.

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See Roller Bearings.

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Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
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Newton Mach. Tool Wks., Philadelphia, Pa.
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Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

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New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford Conn.
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Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
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Phoenix Mfg. Co., Hartford, Conn.
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Federal Mfg. Co., Cleveland, O.
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Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
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Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co. New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

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Faneuil Watch Tool Co., Boston, Mass.
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Caldwell, Son & Co., H. W., Chicago, Ill.
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Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

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Thompson, Hugh L., Waterbury, Conn.

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Long & Allstatter Co., Hamilton, Ohio.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter Ltd., New York.
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Tower, A. B., Rockwell, Fla.
Vandergrift Coupling Co., Evansville, Ind.

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Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

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Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

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Universal Drafting Mach. Co., Cleveland, O.

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Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

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Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

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Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
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Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
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Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
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Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

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Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
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Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
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Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

File and Tool Holder
Bowers, Geo. W., Waltham, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburgh, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

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Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
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New Britain Mach. Co., New Britain, Conn.

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Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

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Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, H. G., St. Louis, Mo.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Russell, R. M., Binghamton, N. Y.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Russell, R. M., Binghamton, N. Y.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.

Grindstones
Cleveland Stone Co., Cleveland, O.
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co. New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
French Mfg. Co., Kansas City, Kan.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathe Feed
Natonal Mach. Tool Co., Cin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Tanite Co., Stroudsburg, Pa.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Frothingham, N. L., New York.
Stevens & Co., Milo B., Washington, D. C.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Ct.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Machinery Exchange, Chicago, Ill.
Prentiss Tool & Supply Co., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Ball Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Pratt Institute, Brooklyn, N. Y.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reade & Co., Wm. A., Cleveland, Ohio.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Foundry & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Hermann Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Hermann Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburgh, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Straightener, Screw
Towsley Mfg. Co., John T., Cincinnati, O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Trucks, Shop
Towsley Mfg. Co., John T., Cincinnati, O.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincinnati, O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

A New Profiling Machine.

We illustrate herewith a new profiling machine brought out by the Pratt & Whitney Company, of Hartford, Conn. The half-tone gives an excellent idea of the general appearance of the machine, and the line engravings show the spindle and head construction and the arrangement of the driving gears.

The bed of the machine is of stiff proportions and provided with a tank for holding oil or other lubricant that may be used on the work. Two cabinets also are placed in the bed for holding cutters and other tools. The table, which has a working surface 12x15 inches and a movement of 23½ inches, rests on one "V" and one flat way, as shown. An oil channel is formed around the table, and all lubricant is caught and returned to the tank below. The gears and racks, by means of which the table and saddle are moved, are made double and may be readily adjusted to take up any backlash.

The spindles are driven by spiral gears from the horizontal shaft shown at the back of the head, the cone pulley at the end of the shaft being belted direct from the countershaft. This cone runs on the outside of the driving shaft bracket, thus relieving the shaft of all strain due to the belt pull. The cone has three steps, the largest of which is 11 15-16 inches in diameter, and takes a 2½-inch belt. The

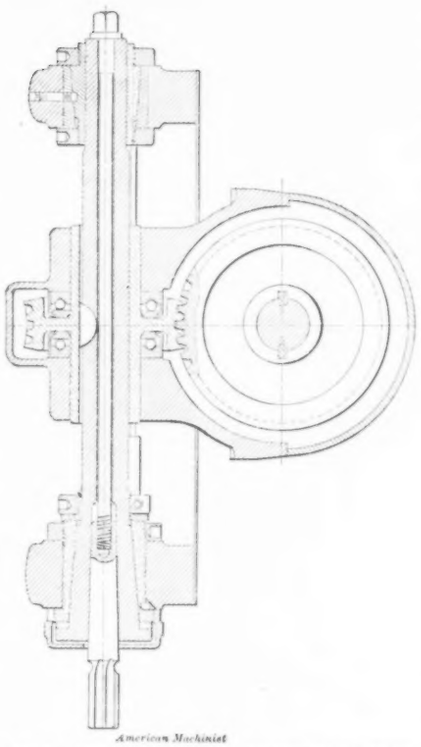


FIG. 2. VERTICAL SECTION SHOWING SPINDLE AND DRIVING GEARS.

spindles, which have No. 7 "Jarno" taper holes, are ground to size and run in bronze boxes. The lower bearings are conical and the upper cylindrical, as shown in Fig. 2. Provision is made for taking up wear at either top or bottom, and end thrust is taken at the lower bearing by a Babbitt metal washer.

The manner in which the spiral gears for driving the spindles are carried is

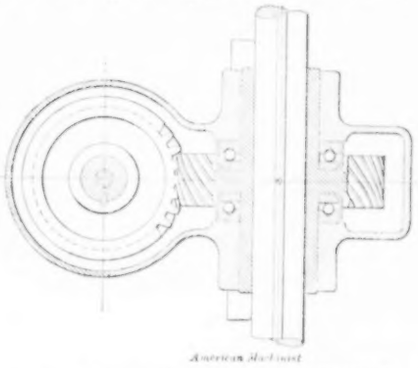
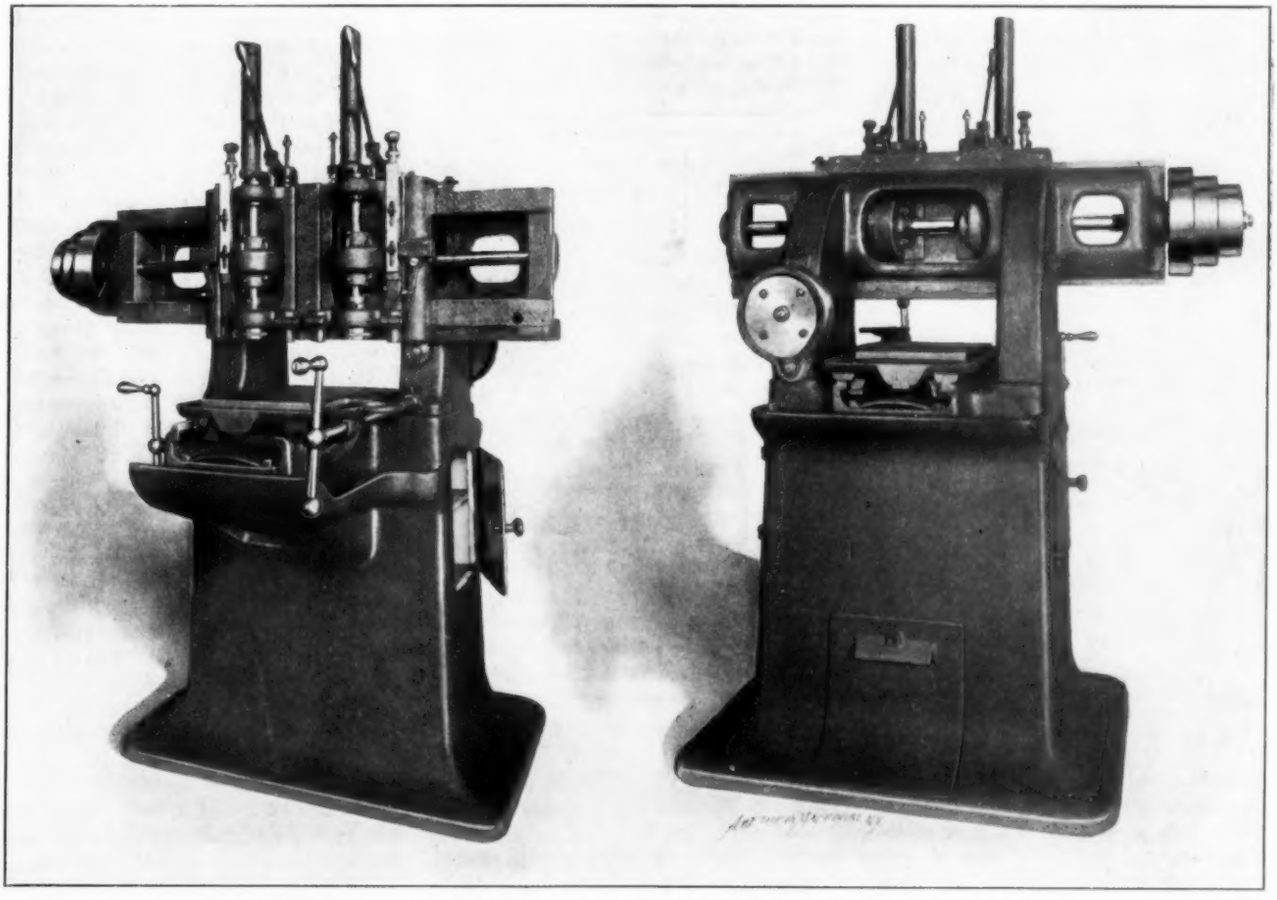


FIG. 3. HORIZONTAL SECTION THROUGH SPINDLE AND DRIVING GEAR HUB.

shown in Figs. 2 and 3. The gear shown on the shaft is driven by two long keys fitted in opposite sides of the shaft, and both this gear and the gear shown on the spindle are provided with long hubs journaled in a bracket bolted to the back of the saddle. Thus there is no crowding action on the spindle, and it is at all times free and sensitive. The driving gear is of steel and the driver of phosphor bronze.



FRONT VIEW. FIG. 1. NEW PROFILING MACHINE. REAR VIEW.

The gear casing is oil tight and arranged to be filled with lubricant. The spindles may be run at a speed as high as 1,200 turns per minute if desired, and as ball thrust bearings are provided at the sides

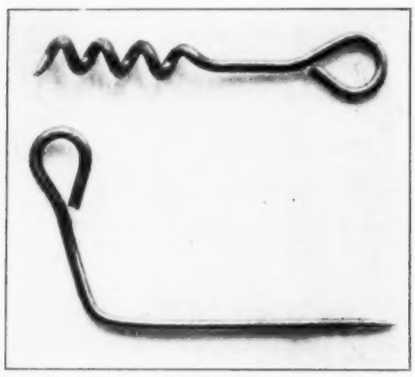


FIG. 1. A CORKSCREW AND THE WIRE BEFORE THE TWISTING.

of each gear, the spindles will work equally well when running in either direction.

The heads, which have a vertical movement of 3¼ inches, are raised when not in use by stiff enclosed springs. Either head may be lowered and its cutter quickly brought into position by operating a lever at the top. Each head carries an adjustable bar cut out to receive the end of a locking bolt by means of which the head may be located in its proper position. To facilitate the adjusting of the bar a screw is provided which carries at its end a micrometer dial. Stop screw and nuts are

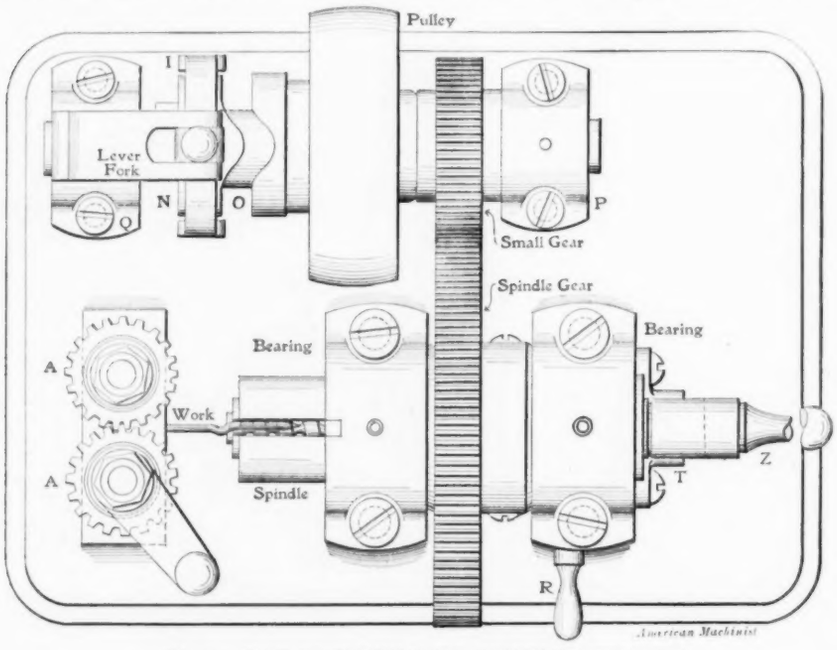


FIG. 2. PLAN OF MACHINE FOR TWISTING CORKSCREWS.

also provided for stopping either head at any desired point.

The right-hand head, it will be noticed, is so arranged that the former or guide pin may be carried at either side of the spindle. In making a former from a sample piece secured to the table, the pin is clamped in one of the sockets shown and kept in contact with the model while the former is being milled. After the former is completed the pin is changed to the opposite socket and kept against the former while the cutter is operating on the work.

The saddle of this machine (called by the makers their No. 12 machine) has a movement of 26¼ inches. The distance between uprights is 19 inches, and the distance from the top of the table to the bottom of the saddle is 5¼ inches. The countershaft has tight and loose pulleys, 14 inches in diameter and 3 inches face and should run at 175 turns per minute. The net weight of the machine is 2,650 pounds.

A smaller size two-spindle and a single-spindle machine also are made, these being of the same general design as the machine illustrated. An oil pump with suitable piping can be supplied for any of these machines when ordered, and a friction countershaft can also be furnished.

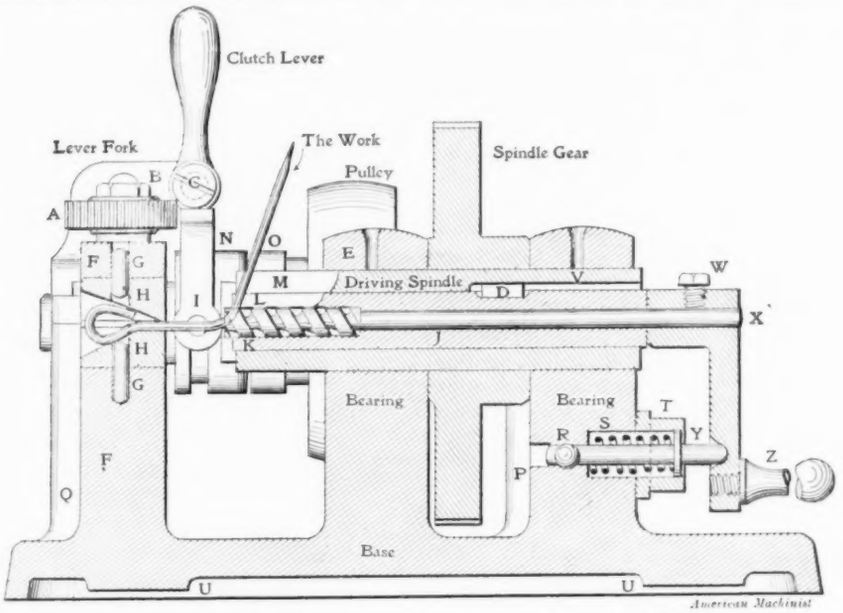


FIG. 3. VERTICAL SECTION OF MACHINE FOR TWISTING CORKSCREWS.

A Machine for Twisting Corkscrews.

BY JOSEPH V. WOODWORTH.

The machine here shown was made for twisting wire corkscrews of the type shown in Fig. 1. The wire before the twisting is shown below the corkscrew. It is "looped" at one end and bent, while the other end is pointed. The cutting off of the length of wire and the pointing of one end are accomplished in one operation by means of two simple tools in the monitor; the tool used for pointing being a "needle" box tool, and the one for cutting off a "chopping" tool of a construction similar to a wire-cutting device described by a fellow contributor some time ago. The second operation on the wire lengths, that of bending and forming the "loop," is done by hand, with a simple bending fixture not of sufficient interest to show here.

The drawings of the twisting machine show its construction and little description will be necessary. The machine consists of, first, a body or main casting on which are four standards for bearings for two shafts. The pulley, clutch and small driving gear require no explanation. The wire is clamped between two jaws *H H*, Fig. 3, the upper one of which is raised or lowered by the handle and two gears *A A* turning right and left screws. The mandrel or forming spindle *X* is of tool steel finished to fit easily within the sleeve *K*, which in turn is fitted and keyed to turn with and slide back and forth within the main spindle *V* by a key at *D*. A handle at *Z*, fastened to the forming mandrel by the set-screw *W*, keeps the mandrel stationary by a round-headed pin entering the back at *Y*, while the sleeve with the main spindle rotates and twists the

wire. This pin is located in the bracket *T* with a spring at the back at *S* and a handle at *R* to allow of its being forced back when the mandrel lever is to be turned.

When the machine is in use the work

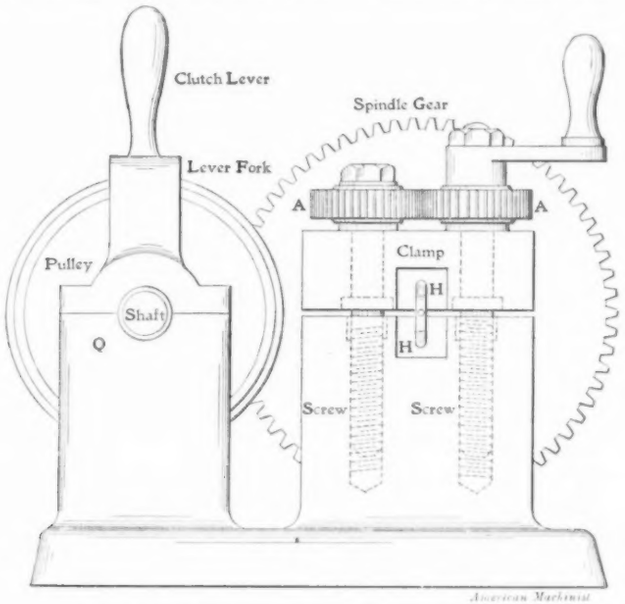


FIG. 4. END OF MACHINE FOR TWISTING CORKSCREWS.

is located and clamped between the two jaws *H H*, with the pointed end lying in the slots *L* and *M* of the sleeve K and the spindle *V* respectively, and the handle of the forming mandrel located and held by the pin *T*, Fig. 3. The clutch lever is then pulled back and the spindle *V* and the sleeve *K* rotate while the forming mandrel remains stationary, thus twisting the wire around the mandrel to the shape shown in the half-tone. The clutch lever is then pulled out and the machine is stopped, when *Z* is released and turned toward the left, thus drawing out the sleeve and mandrel and leaving the finished corkscrew so that it can be removed by loosening or raising the upper jaw *H*. The mandrel and sleeve are then slid back in position, another piece of wire is located and the operations are repeated.

Facts About Sewing Machine History.

The recent Census Bulletin on Sewing Machines contains some highly interesting facts from which we extract the following:

"The mechanical development of the sewing machine has been almost wholly confined to the United States and has been accomplished within the last half century. The census of 1860 for the first time shows the statistics of sewing machine manufacture. From the time the first sewing machine patent was issued to John J. Greenough, in 1842, until the year 1900 the total number of patents issued in the United States on sewing machines and attachments was 8,943, of which only 10 were issued prior to 1850.

. . . . . .

"The double-pointed needle with the eye located in the center was the first to be applied to mechanical sewing, and was introduced by Charles F. Weisenthal in England, where he secured a patent June 24, 1755. The needle was intended only for hand embroidery, and not until 1770 was the principle applied to sewing machines. In this year Thomas Alsop patented a machine in England which used the double-pointed needle for embroidering purposes. The first officially recorded attempt made in the United States to construct a sewing machine on the principle of the short thread and double-pointed needle was by John Greenough, who built and patented a machine in 1842. It was designed for sewing leather and other hard material, an awl piercing a hole in advance of the needle.

. . . . . .

"Greenough's sewing machine, like similar attempts at mechanical stitching which embodied the features of the through-and-through stitch and short thread, was of no practical use; but it possessed some valuable points and holds a creditable place in the history of the industry.

"Inventors early sought to apply the old crochet stitch to mechanical sewing. Among the records of the English patent office has recently been found the design ot a sewing machine intended to execute the old crochet stitch which was patented by Thomas Saint, July 17, 1790. This machine is the first attempt at mechanical sewing, so far as any official record shows, and this makes more remarkable the fact that many of the essential features of the modern sewing machine are embodied in the design of the Saint machine. These features are crude, it is true, and may never have been practical in their operation; but the fact remains that the horizontal feed plate, the overhanging arm carrying on its end a vertically reciprocating straight needle, and the intermittent automatic feed were first incorporated in a design of over a century ago. It is not known that the machine of Thomas Saint ever existed save on paper, as the only history of the inventor or his machine is the record in the English patent office. If this record had been discovered twenty years earlier it might have changed the entire course of the sewing machine trade of the world, and would have weakened, if not destroyed, more than one of the patents since granted.

"The first machine on official record which was put to practical use was patented by Barthelemy Thimonnier in France in 1830, and subsequently in the United States and England. This invention was so far successful that in 1841, eighty of the machines made of wood were in use for sewing army clothing in a shop in Paris. These were destroyed by a mob, as had been the Jacquard loom and similar labor-saving devices years before. Thimonnier made another attempt in Paris to introduce his sewing machine and apply it to practical uses. He succeeded in producing a set of machines capable of making 200 stitches a minute, and sewing and embroidering any material from muslin to leather. This set of machines was constructed of iron and followed the general model of the original machine, but with several improvements. In 1848 the inventor was again assailed by a mob, which destroyed all his machines and barely allowed him to escape with his life.

. . . . . .

"In England, in 1841, Newton and Archbold patented a chain-stitch machine, using the eye-pointed needle. The needle passed the thread through the cloth and formed a loop which was seized by a hook and carried forward. On its next trip the needle would pass through the loop thus made and form a single-chain stitch.

"The great advantages of the eye-pointed needle, however, were never fully appreciated until the invention of the lock-stitch, which is made by passing the thread through the fabric by means of an eye-pointed needle, and then passing another thread through the loop thus formed, the second thread interlocking with the first in the middle of the fabric. This idea was first conceived about 1834 by Walter Hunt, of New York. He built a machine embodying the eye-pointed needle and the shuttle, which, so far as is generally known, was never sufficiently perfected for practical use. He failed, however, to protect his ideas by patents, as required by law, and consequently failed to reap the reward of his genius. Hunt never fully appreciated the importance of the opportunity he had allowed to slip by until years later, when Elias Howe, Jr., patented a machine which was similar in the results accomplished to his own. He then attempted to assert his prior claims to a patent, which was denied him on the ground of abandonment.

"The sewing machine patented by Elias

Howe, Jr., September 10, 1846, technically marks the beginning of the industry in the United States. At this time the sewing machine was still in the experimental stage, and it was not until several years later that its manufacture became an established industry.

. . . . . .

"It is not known that any of Howe's machines were ever put upon the market. In his application for renewal of patent he only claims to have built three machines, and one of these was deposited as a model in the United States Patent Office."

Few are aware of the extent of the export trade in sewing machines. From tables in this bulletin we learn that for the decade ending 1900 the total value of these exports exceeded $30,000,000.

Cataloging Small Machine Parts.

BY L. P. ALFORD.

In large factories producing a varied line of similar machines, such as sewing machines, typewriters or shoe machines, one of the problems which comes before the superintendent of production is to make use as far as possible of the stock of small parts such as screws, pins, nuts, etc., in new designs and thus avoid duplicating these stock parts on new machines, and under new names or numbers.

The advantages of this course are obvious, but to obtain them data regarding what parts are stock must be placed at the disposal of the designers and draftsmen. One of the three following systems for furnishing these data is generally used: A sample board may be arranged having the small parts attached in a more or less systematic manner, either with or without notes, giving their general dimen sions and names or numbers; or a list may be prepared to be blueprinted or otherwise duplicated, giving the general sizes of the small parts in tabular form with or without a reference drawing showing the general outline; or again, a book either blueprinted or printed in some other form may be made having the parts arranged according to kind and size with dimensions given in tabular form under letter headings, these same letters appearing as dimensions on a reference drawing at the top of the sheet.

The sample board, while convenient for a few parts, is very limited in its range, is not portable, is bulky and awkward to handle and is unhandy to keep up to date, since the insertion of a new sample in its proper place may mean the moving of an entire row of samples already attached. The list or book is an improvement on the sample board, it being easily carried about and ample to contain all of the data which are at hand when it is prepared. However, corrections and changes cannot readily be made, and when it is necessary to make additions oftentimes they cannot be entered in their proper places. Furthermore, there is a certain inconvenience in picking out the dimensions because it is necessary to note the letters on the drawing at the top of the page, the letters heading the various columns, and finally the dimensions wanted, making three operations where one only should be necessary.

In view of the disadvantages of the systems outlined, the following system of cataloging and arranging the data regarding the small parts of about 150 machines brought together under one management by a series of consolidations was developed:

Nine general classes, called lists, were established and each was given a symbol. Seven of these cover the screw machine work: Screw List (S L), Nut List (N L), Pin List (P L), Stud List (St'd L), Washer List (W L), Roll List (R L), and Collar List (C L). The other two are the Spring List (Sp'g L)and Wrench List (Wr'h L). Each part considered entered some one of the nine lists and was given a number by which it is known in all records and which is stamped upon the part itself. The advantage of the symbol lies in shortening the designation used on drawings, etc. A part can be called for as "21 S L," which is shorter than "21 Screw List."

The numbers were started at 1, the upper limit being considered 10,000, as at that point it would be necessary to stamp five figures upon the parts, which is impracticable in many cases. This range is ample for the largest list. The screw list contains practically 1,500 parts.

To show how many parts of a machine fall into the nine lists, a new machine recently cataloged, which is representative in its general design of a large class, contains 152 parts, of which 91 were cataloged in the lists, or about 60 per cent.

The data relating to all the parts numbered and listed in the nine general lists were collected and arranged in a card catalog, each card being devoted to a single part and being practically a detail drawing of that part.

The cards are of standard size, 4x6 inches, and printed with a uniform heading (see Fig. 1). This heading is for indexing purposes mainly, the cards being filed in groups according to style, and these groups according to size, the smaller in front. The data following the word "Material" furnish an additional dimension in some cases, as will be shown later. The use of the list and list number has been described.

Upon these cards were printed cuts which are practically detail drawings of the various styles of screws, etc., with the dimensions left off, as shown in Figs. 2 and 3. The plates used in printing these cuts were made from an ordinary inked drawing on bond paper. The data were then filled in upon these cards from the detail drawings, as in Fig. 4, which illustrates a finished card. This card is in reality a detail drawing, made in an inexpensive manner, being, however, in some cases, disproportionate and to no scale. These latter features constitute no disadvantage—the dimensions only being followed. The number of dimensions was kept as small as possible, only such being given as are absolutely necessary. For example, in Fig. 4 the size of the head of the hexagon head cap screw is given by the size of stock following the heading "Material."

If the cards are made of a good quality of paper it is an easy matter to make freehand changes in the cuts and thus adapt them to special cases.

The cuts covered the general styles of parts in the lists, the following being the most important:

Screws.—Round head cap, square head cap, hexagon head cap, flat head cap, round head shoulder, square head shoulder, hexagon head shoulder, square head set, headless set, thumb, adjusting.

Nuts.—Hexagon, square, collar, slabbed, spanner.

Pins.—Dowel, fulcrum, cotter, spring.

Springs.—Tension, compression, torsion.

Washers.—Finished, punched.

Rolls.—Cam, solid, straight.

Collars.—Set-screw, taper pin, distance.

Studs.—Collar, fulcrum, dowel.

Some difficulty was encountered in obtaining specific names for the various styles of parts. No authority could be found which attempted to treat of these small parts in detail and name them in a systematic manner. The nomenclature used by machine screw makers in their catalogs is not uniform, and many styles of screws, nuts, etc., illustrated in such catalogs are not specifically named.

The catalogs of manufacturers who name their parts in detail, as of sewing machines and shoe machines, contain many contradictions—using the same name for different styles of parts and, in some cases, several different names for the same style.

This problem was finally solved by establishing a series of names for the styles of parts in the nine classifications, having these as consistent and uniform as possible, using the names found in catalogs of machine screw manufacturers as a basis.

The two following arbitrary rules were found necessary at the outset:

"All parts usually considered as either screws or studs, having a screwdriver slot or wrench head and not entering the classification of pins, shall be listed in the Screw List. All other such parts shall enter the Stud List."

"All parts usually considered as either studs or pins and having a threaded portion shall enter the Stud List. All such parts not having a threaded portion shall enter the Pin List."

There are several distinct advantages of this card system over the other three described. First, perfect elasticity. Any number of data, many or few, can be cared for; new material can be added, obsolete

material destroyed or changes made with the greatest ease and perfect indexing maintained throughout. Second, utility. The data wanted can be very easily found, and being in the form of a detail drawing are much more easily and quickly grasped by designer or draftsmen than if in tabular or list form. Third, constant accessibility. If as in the case described, several duplicate catalogs were to be made out for use in the drawing rooms of several factories (the data for keeping them up to date to come from a central office), the card catalog can be corrected without being returned, thus leaving it always accessible and ready for use. Fourth, inexpensive maintenance. The cost of additions and corrections is very slight after the file is established.

The cost of installing such a system depends upon the condition of the original data. If these can be taken from detail drawings the expense is slight compared with the cost of measuring model or sample pieces. The cost of the cards, ready to use, averages about $2.85 per thousand; $2 for the card with printed heading, 25 cents for the plate to be used in printing the cut, and 60 cents per thousand impressions for printing the cut.

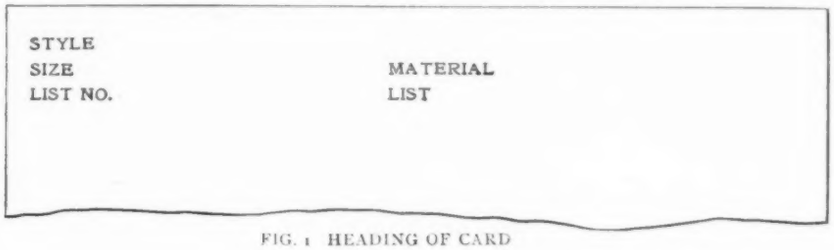


FIG. 1 HEADING OF CARD

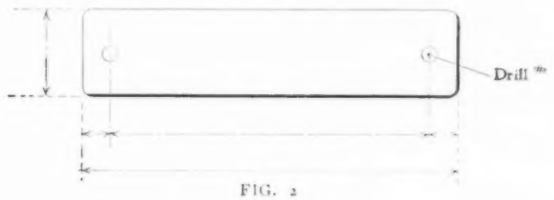


FIG. 2

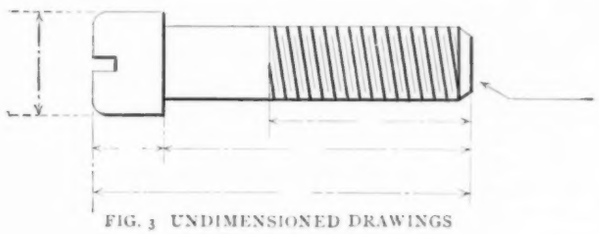


FIG. 3 UNDIMENSIONED DRAWINGS OF PARTS LISTED

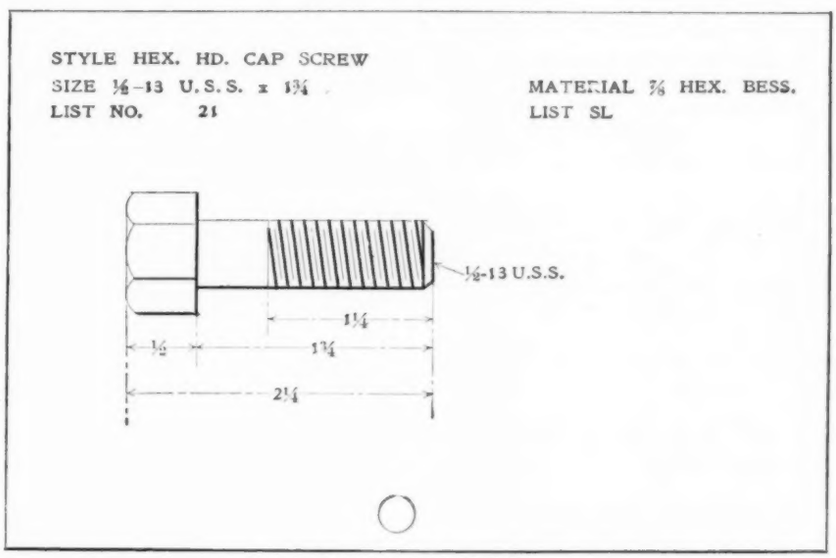


FIG. 4. A CARD FILLED IN.

The spacing of the printed heading should correspond with the spacing of the typewriter which is to be used. This will save enormously in the time of writing. In our experience a good stenographer can write about 1,000 cards per week, putting on all data, except the vertical dimensions on the cut.

In case it does not seem advisable to go to the expense of getting a plate and printing a quantity of cards where only a few are needed, this small lot can be printed easily and cheaply by using the wax paper stencil process or any of the standard duplicating processes which will admit of the use of drawing instruments in making the original.

This same general system can be developed to catalog other general parts which do not enter into the nine lists, as pulleys, gears, bushings, rods, handwheels, etc. The card can be used with the printed heading as shown in Fig. 1, but instead of having a printed cut, make a reduced carbon print—of suitable size to paste upon the card—from the original tracing or bond-paper drawing. These reduced prints can be made without a negative by placing the sensitized paper in the camera in place of the plate and printing directly from the drawing, the lens of the camera making the reduction. A print 3¼x5 inches will go nicely on a 4x6-inch card, and if this is reduced from a 16x24-inch drawing it is readable to a person with normal vision. If a person is unable to read the figures when thus reduced, a reading glass will cure the difficulty, or reference can be made to the file of original drawings or blueprints, the card showing the style and general outline and giving the name and number. This difficulty is not great, as most of the pieces which it would be advisable to so catalog are detailed on 12x16-inch drawings, or even smaller, and a 3¼x5-inch reduced from this size is readable by anyone.

This method of cataloging the parts indicated is rapid and inexpensive, and it has all of the advantages brought out in connection with the screws, etc.

The rule which was followed in selecting parts to enter these catalogs is: "Place in the catalogs all parts which are of such a general character that they may be used in future designs." In case there is a question as to the advisability of putting some particular part into the catalog, it is better to err by putting it in than by leaving it out, as often such questionable parts are the very ones required in new designs.

Municipal Insurance Against Unemployment.

At the recent meeting of the American Association for the Advancement of Science, Henry J. Harris, of the Department of Labor, Washington, D. C., read a paper with the above title which is summarized by *Science* as follows:

"The four cases which force the workingman involuntarily to become a burden to society are accident, sickness, general invalidity and lack of employment. The first three of these have been more or less successfully removed from the field of

charitable effort and relief for them placed on the basis of insurance; attempts are now being made in various European countries to place relief for employment on a like basis.

"The first attempt to accomplish this was made in the city of Bern, Switzerland, in 1893, by establishing a municipal office for voluntary insurance against unemployment. The plan finally adopted was to charge the members of the Fund the sum of fifty centimes per month as dues, and in case of a member becoming unemployed —through no fault of his own—during the months of December, January and February, he was paid one and one-half francs (or two francs if others were financially dependent on him) per day for a period not exceeding sixty days. With modifications to suit local conditions, similar funds have been established at Basel, Cologne and Bologna; the four funds have memberships ranging from 160 to 1,200 persons each; the insured persons pay between 13 and 30 per cent. of the total cost of the insurance, the deficit being met by contributions of private persons an l municipal subsidies.

"In August, 1901, the city of Ghent, Belgium, adopted the plan of increasing, under certain conditions, by 50 per cent. the out-of-work benefits paid by the trades unions of the city to their members. The plan has met with favor in other localities and is used by the city of Dijon, France, and the province of Liege, Belgium. About 13,000 persons are now insured under this system."

Echoes from the Oil Country.

HABITS.

That anything that produces a larger output in the shop is of importance no one will deny. It would seem to follow that things are of importance in proportion to the effect they produce on the output. We often read of tests in fuel economy where a saving of 5 or 10 per cent. over a competitor is enough to go before the purchaser with as not only very desirable but almost the difference between success and failure.

In looking around for ways to try to keep up with the procession I have found that the human element is there and must be taken into account.

In the late practical demonstration of theories due to a difference in practice between this country and Spain we used to hear a great deal about "the man behind the gun," and it is pretty well recognized that the "man who runs the lathe" and the rest of the machine shop equipment is just as large a factor as the machine he runs is.

Of course we know this—everybody does. We all know about it, and we know all about it. We know it so well that we forget we know it and often go on just as though we didn't know very much about it. I am speaking now of the men in the shops, us fellows whose business it is to do things and keep on doing them. We are not the only sinners though, as the people who design the machines we operate sometimes forget it is going to take anyone to run them.

If there is one thing more important than another in our way of doing things, habit is that thing.

One of the most striking remarks I've heard for a long time was when a young man very quietly and decidedly told me he hadn't any habits.

"You don't mean habit in the broadest sense by that," I remarked, "but the evil and disagreeable ways that some people fall into."

"I mean that I am entirely without a habit of any kind. I've made up my mind that I would not be a slave and have always watched myself closely, and now I can say that I am absolutely without a habit."

He appeared sane, and spoke with the air of a man who believed what he said. It was my busy day and I had no time to argue or investigate; also he was young and had time to learn some things.

I thought "Strange, *if true,*" and wondered if he was right or left handed, which eye he shut when he squinted at something, and how he did the hundred and one little things we never think about, yet do every day and always in the same way unless something interferes.

That little lathe used to have not much to do and the first one to run it steady was a boy who had never run a machine before, except to do some drill press work. When I was put in charge of a night gang I had to have a man on it, and the fun began at once.

The lathe was old, and at some time the screw and nut on the cross carriage had given out and some "enterprising genius" had put in new ones. To save time and trouble, he had used a ¾-inch right-hand tap to tap the nut and tnen made the screw to fit it.

The man I put on that lathe had been at the business long enough so that he had several habits, and one was the habit of supposing that all these screws are left-handed and acting accordingly.

When the first spoiled job was shown to me I told him to go a little slow for a night or two, until he got used to it. As the job he was on was only turning he did fairly well, but by and by along came a job of thread cutting, and then there was music.

"Come over here a bit, will you, boss? I'm in a peck of trouble, that —— —— —— (It would really make very improper reading, but the experience of my brother machinist will tell him just how it sounded) screw ought to be in —— (a place where good machinists will be very scarce) along with the man who put it in, and the man that allowed him to do it ought to keep them company."

This was not meant as a reflection on me, as he well knew I had nothing to do with it, but showed me that something very disagreeable had happened.

Those threads were a sight—jammed in at the point, gouged in at the end, full of humps and hollows.

"You just try one; that will show you better than anything I can say," said the man. I did and nearly wished I hadn't. With it firmly fixed in my mind that the screw was the reverse of the usual, I started up. In doing this I found that the shipper pulled toward the tailstock to start up. Abomination! I had been used to its going the other way; still, as I had not done machine work for between four and five years, I guessed it wouldn't matter much.

The thread was to run up to that file mark and I would draw the tool out just on the line, at the same time with a swift, graceful sweep of the arm reverse the lathe just as the tool quit cutting.

Here we are at the mark and the time for action is here; a quick whirl of the handle and a jerk on the lever and—snap, bang, dodge. Habit helped me to throw the belt off the cone before the face-plate got a chance to try to chew the tool-post block up, but there is a broken thread tool, and around on the floor somewhere is the piece I was using to illustrate my freedom from habit and to show the other fellow how to cut a thread. The reason I hadn't pulled the shipper in two was because it was a good strong one.

I found that if I got to watching the tool cutting I was not even sure of pulling the shipper the right way, and even after the lathe had stopped I could not give the handle the right turn to withdraw the tool without a distinct effort of mind.

I had a new nut and screw made. It was made on that lathe and it took an awful time to get it done. I think most of the time the man pulled the lathe by hand, and he would stop and study a while at each end of the run before moving the handle. We got it in before morning, and I hid the old screw and nut and reported the change to the superintendent and also explained it very carefully to the boy who ran the lathe days. He had all sorts of fun with his work for a time and tried hard to find the old screw and nut—said he was willing to put them on for days and let us use the other ones for nights if we wished.

I don't believe there are many shops that would tolerate such a screw very long, but where is the lathe man who has not at some time gotten into trouble because of the uncertainty as to which way the tailstock screw works.

In some shops it is considered of much greater importance to have the driving belts straight and the backing belts crossed than it is to have the forward motion of the lathe caused by a forward push of the shipper. In some places even a little time or expense in putting up the countershaft is allowed to decide the matter.

For myself I believe that all machines

should start with a motion of the shipper from right to left; that is, the same as toward the headstock in a lathe.

The mechanic who has made a grab for the shipper when there was no time to think and when failure meant serious bodily injury to himself or a fellow-workman or harm to costly work or a valuable tool knows how important this is from that standpoint. Such times come to most men sooner or later and from the standpoint of being able to do the work with one less point to keep in mind it is worth attention. If the AMERICAN MACHINIST, or A. S. M. E., or the I. A. of M., or Metal Trades' Association, or some other power in the machinists' world will fix a standard for the tailstock screw, I will try to see that wherever my word is of use nothing else gets in.

Many a good machine has been a failure because it did not harmonize with fixed habits of the users. Sometimes this is unavoidable, yet often a little thought on the part of the designer would help things immensely.

But there is another place where habit plays a very important part. This is the day of systems, and the shop without at least one is away behind the times. Some systems fit the shops and some nearly give the men fits. Any system that the men have to help with that works contrary to usual habits will have to be exceedingly valuable to justify itself, and this without any conscious opposition from the men.

Try for a few days to do a few of the common things of life a little differently. Put your coat on other sleeve first and button it with your other hand. Carry your knife and lead pencil in different places and never reach the wrong place for them and you will begin to see that to go contrary to habit takes nerve force that can be used otherwise.

I had a good helper quit one day; his trouble was having to make out a time sheet—not an elaborate one either, but one showing how much time, approximately, he was on new work; how much helping, and how much cleaning shop. "No trouble about the work; the work is easy, but I can't stand so much bookkeeping," was the way he expressed it.

If "Dutch," whose article "How to Brace up a Shop," at page 1022, has plenty of food for thought, will have patience and do enough hard work he can make a great change, but it will come little at a time. If he cannot spare the time to do it himself, he had better get a "Law and Order" foreman whose entire business will be to keep drilling the men into putting things away until that becomes habit with them; then by watching new men closely for a time to see that they fall in line properly he should not have much trouble. This one man should do the thinking on this subject for the whole shop.

"Dutch" will know that what would be considered good for one shop under its conditions of room and work would be considered very bad indeed by another shop working under different conditions, and also that habits that require no exertion to acquire are more readily formed than those that require hard work. It is hardly necessary to call attention to the fact that the really valuable ones are generally the hardest to form.

I think every book on machine designing should have a chapter on "Habits of Workmen," while in every work on shop management, in addition there should be some chapters on "Habits of Different Trades," "Habits of Different Nationalities," "Ways to Form and Break Habits," etc. Of all the equipment of the mechanical engineer who expects to have charge of work and workmen, this knowledge will not be found the least valuable.

To move along the lines of least resistance is certainly good practice and to go out of the way to create unnecessary friction is not evidence of a wise man, be he workman, foreman, superintendent or designer.

Don't be a slave to habit, but make your habits be your slaves. The more good ones you have working for you the more work you can do and the easier it will be to do the work.

It is well known that during normal times it is hard for a man from one kind of a shop to get a job in some other kinds. The foreman of the country job shop will not take on a man who learned his trade and always worked in a manufacturing shop, if he can help it. The man used to fine tool work and finish feels out of place in an agricultural works and wants to do his work too well, and this in spite of the fact that he sees it will pass much rougher.

Once a man worked for some time on fine, well built, well finished, high-class, high-speed steam engines. Afterward he got a job in a shop where they built engines that were used on rough work and handled by men as rough as the work. In each place he worked on the erecting gang. Mindful of the trouble they had with engines in the first place in spite of the most careful work, he looked for nothing short of positive disaster from the work done in the second place, where, to use his expression, the engines were "thrown together." He was surprised and somewhat disgusted to find that these cheap engines started up and ran without trouble and kept doing it, being as well suited to their place as the fine ones to theirs.

The man who can go to any shop he finds and suit himself to the conditions he finds there, so as to rank up with equally good mechanics there without loss of time, has some valuable habits of mind to offset the habits that come from doing a thing over and over, and it is the lack of these that gives the others their firmest hold.

Some shops have a wide reputation for turning out good workmen, while others turn out men that few shops want.

My experience is that the difference comes more from the habits the boys acquire than from any difference in the boys to begin with, although the good shop is usually more careful to try to know what kind of habits a boy has before they will take him.

"It is hard to teach an old dog new tricks." W. OSBORNE.

"Racing" as a Cause of Flywheel Accidents.

In our article on "Safe Speeds for Flywheels," published in a previous issue of this journal, we pointed out that "for a given material there is a definite speed at which disruption will occur *regardless of the amount of material used.*" In that article we gave the formula

$$V = 1.6\sqrt{\frac{S}{H}},$$

from which any engineer can readily determine for himself whether or not the flywheel on his engine is running at dangerous speed.

If now we square both sides of this equation and solve for S, we obtain the formula

$$S = \frac{H V^2}{2.56},$$

from which the stress tending to burst the rim asunder may be obtained for a wheel made of any material and running at any speed.

Stated in words, the formula means that if we multiply the square of the velocity of the rim in feet per second, by the weight in pounds of 1 cubic inch of the material in the wheel, and then divide the product by 2.56, the result will be the force in pounds per square inch tending to burst the wheel.*

As a cubic inch of cast iron weighs about .26 of a pound, this gives for cast iron wheels

$$S = \frac{V^2}{10}, \text{ approximately.}$$

That is, the stress tending to burst the rim of a cast iron wheel is one-tenth of the *square* of the velocity of the rim in feet per second.

From either of these formulas it is seen at a glance that the stress in the rim of a wheel increases with *the square of the speed*, or, to put it another way, the factor of safety on *speed* is always the *square root* of the factor of safety on *strength*.

If the speed be *tripled*, for example, the stress in the rim becomes *nine* times as great as before; that is, with a factor of safety of *nine* on strength, there is a factor of safety of only *three* on speed. It will be understood from this that the stress increases enormously for even a slight increase in speed.

Let us consider the usual cast iron, sectional, belt-wheel having flanged and bolted rim-joints located between the arms. As pointed out in our previous ar-

*Bending stresses have been neglected in order to simplify the formula.

ticle, such joints average a strength of only *one-fifth* the strength of the rim, and no joint of this kind can be designed that will have a strength greater than *one-fourth* the strength of the rim.

If this wheel had at normal speed a factor of safety of 12 in the rim, then with joints of maximum strength the factor of safety in the joint would be only 3 on strength or 1.73 on speed. That is, an increase in speed of 73 per cent. would burst the wheel.

The wide gulf in this case between the *apparent* factor of safety of *12* on strength and the *real* factor of safety of *1.73* on speed is appalling. This is, however, only another warning that things are not always as they seem.

As a matter of fact, few wheels have a margin of safety of 73 per cent. on speed. In the accident at the Amoskeag Mills, in which a 30-foot wheel wrecked the building, killed two girls and badly injured the assistant engineer, the evidence proved that an increase in speed of only 20 per cent. caused the disaster. Many wheels in use to-day are running on a narrower margin than this.

It will now be understood why racing is so frequently a cause of flywheel accidents. Some slight accident to the governor or valve gear of the engine occurs, and away goes the wheel, causing a costly if not fatal wreck. The stress in the rim increases so rapidly with increase of speed that sound wheels, amply safe at normal speed, go to pieces without warning, and apparently without cause.

An interesting feature of such accidents is that frequently the engineer is found dead at his post *and the throttle valve closed*. We leave the explanation of this to our engineer friends.—*Bulletin of the Fidelity and Casualty Company.*

Evening Drawing School Methods.

BY ROY JOHN HANNON.

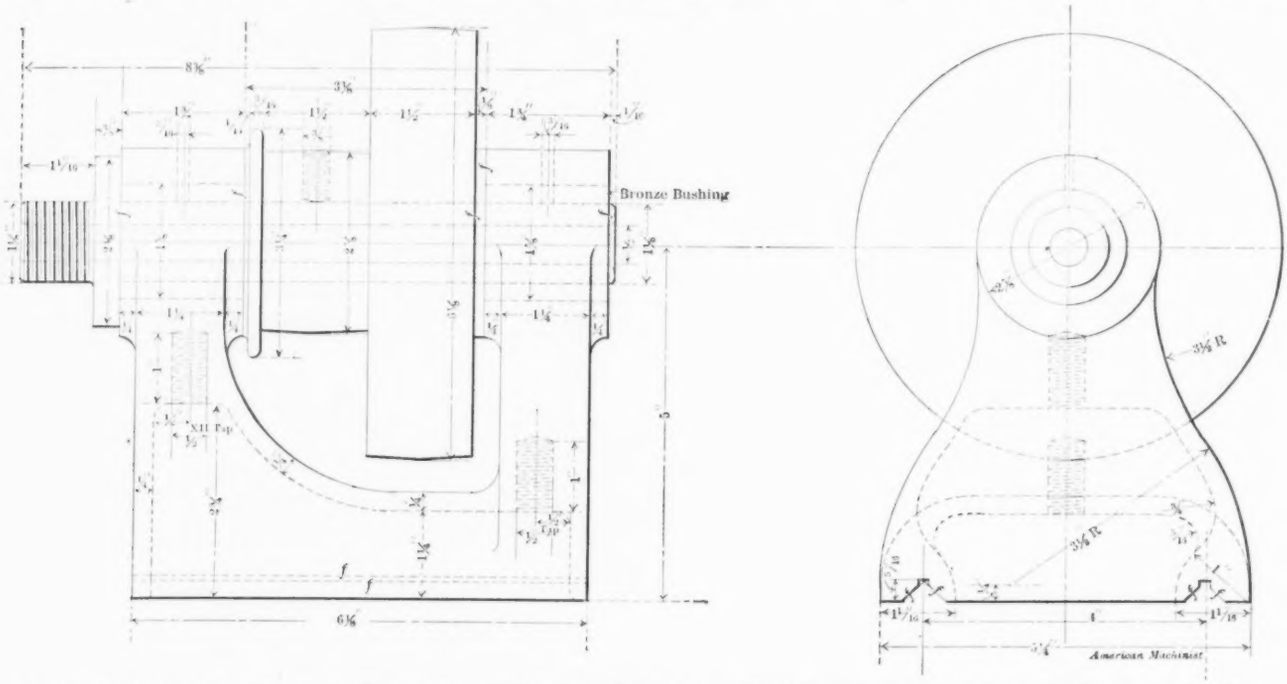
Much has been said and written about high schools, correspondence schools and colleges and their relation to mechanical draftsmen and engineers, but I have seen but little discussion of that extremely important branch of our school system—the evening drawing school—which, I am inclined to think, needs discussion and thought. My experience in this department of education is limited to four years—two years as student and (several years later) two years as teacher—but this experience has left me with the decided impression that the system generally employed could be improved. It is the common and almost universal practice in these classes to follow, in a general way, though in less detail, the courses laid out for day classes. This practice, I maintain, is wrong, for the conditions met are essentially different from those in day classes.

The average day-school student comes, say, to the Manual Training High School with a mind trained to think more or less abstractly, and an imagination supposedly already awakened. His mind is still young and plastic, and he has plenty of time to develop it outside of school hours. He is reasonably certain of four school years ahead of him during which his education may be built up step by step according to a definite, carefully arranged system.

Not so the evening school student. He may be sixteen, eighteen, twenty-five or forty years old. His education may have stopped anywhere from the first year in grammar school to the last year in high school (and I even taught one graduate of Harvard), or he may have "just landed" and know only a hopeless jargon of broken English. Some can stay at school six months, some a year; the percentage that graduates is small indeed.

Ought the course for these men to be the same as for the day classes? If the day-school course were turned exactly *backward* it would come nearer filling its mission. As an illustration of what may be the needs and objects, let us consider three students—one an apprentice in a machine shop who finds himself unable to read a drawing properly, another a young fellow who aspires to become a draftsman (possibly he is already started in the office), and the third a thirty-year-old, first-class journeyman who suddenly finds it necessary to direct the work of others and explain the drawings to them. All these men start to the same school (and what night school has not as typical a group?). To meet the needs of this class in the best possible manner is a hard problem, and cannot be disposed of by a moment's thought or the ever-ready, "Follow the general course of some good high school or standard text book." What these men want, individually and collectively, is the ability to read a drawing swiftly, accurately and with absolute confidence. Even the young draftsman's most crying need is the ability to read surely and keenly the drawings and sketches handed him to follow.

I believe that a good course modeled after the idea that outlines the following



Design: New head stock. *Changes:* Provide for 3-step cone—6½ x 2⅝ x 4 diam., 1½ face; adjustable front bearing; No. 1 Morse taper in front end of spindle.
Remarks: Scale full size For general design follow this head.

MODIFIED DESIGN FOR EVENING DRAWING CLASSES.

would come nearer the evening-school idea than at present commonly obtains:

OUTLINE OF A THREE YEARS' COURSE.

First Year.

(1) Freehand Sketching.—This heading only covers a short exercise in freehand outline sketching of simple models and patterns, principally for the purpose of showing what a drawing is, and as an introduction to machine sketching which comes later.

(2) Detail Drawings.—A pretty thorough course in detail drawings of patterns and machine parts, explaining the proper uses of figures, arrow-heads, witness lines, center lines, conventional signs, finish marks, etc.; also a clear explanation of the uses of the draftsman's tools, especially the triangles and their many combinations for various angles.

(3) Assembled Drawings.—The uses of assembled drawings with a clear idea of what they are to show, by means of a simple practice.

(4) Machine Sketching.—Principally to teach how to figure a sketch properly, and the proper care of sketching pad or paper; use of section lined paper and of carbon paper for duplicate sketching.

Second Year.

Projection, isometric and cabinet; intersection and development; the first principles of gearing.

Third Year.

(1) Conclusion of the gearing course.

(2) Modified machine design.

This seems a logical enough drawing course for the peculiar needs of an evening school. A majority of the students get what they most desire at once. The mechanical drawing interests them and induces them to inquire further, so some of them come another year and are given the brief theory of what they have learned and practiced for a year. The completion of the gearing course, the prospects of real designing and a diploma induce them to come a third year.

The apprentice learns to read his drawing, and practices daily, and when he has gotten far enough along in his shop work to ask questions, the second year's work of theory comes in; and as he approaches the end of his time the "modified design" teaches him to make suggestions or improvements in the work before him, thereby better fitting him for journeyman's wages. In a broad sense the same development may be traced in the young draftsman and in the foreman. I am not aware that such a course has ever been taught, but if it has I know the results would be interesting to hear about.

When I speak of "modified design" I have in mind an idea carried out in one of the New England high schools, with excellent results. The illustration gives an example of these studies. Say the boy is given the headstock of a lathe, or the drawing of it, and told to change it in some important particulars. He may have to redesign the main casting for a different swing, longer cone, larger spindle, or different style of bearings. As such problems are inexhaustible and of almost any degree of complexity, a fine practice may be had from this one study—and no two students need be given the same problem.

Why burden the apprentice with a thesis design he can neither understand nor study up? Why give the young draftsman a design he will have forgotten before he is trusted with such work in the shop? Why take from the journeyman a design he probably copied from some machine you will never be in a position to see? At the end of the third year their work in the shop, if it have any direct connection with drawing, will consist of changing or improving someone else's design. To give them the best ideas of how to accomplish this end is the best that can be done for them.

Some Views on the Metric System Expressed at a Meeting of the Franklin Institute.

At page 236 of the present volume we published the report of a committee of the Franklin Institute on the proposed adoption of the metric system, with an appendix giving a list of questions proposed and voted upon by the committee. We noted subsequently (page 437) that the Franklin Institute had adopted the report of the committee and thereby placed itself on record as being in favor of the introduction of the metric system as rapidly as practicable

In the Journal of the Institute there is published some discussion of this report, and as some of those who discussed it are shopmen and therefore view the matter from the shop standpoint, what they had to say about it ought to be of interest to our readers.

James Christie, chief engineer of the Pencoyd Iron Works, an eminently "practical man," of whose remarkable work we have at times given some account in these columns, was chairman of the committee and in introducing the report spoke as follows:

"In presenting for your consideration the report of the Committee on the Metric System, it is perhaps unnecessary for me to assure you that the results of the deliberations of the committee were not derived hastily, or without due thought and consideration being given to the subject.

"It is a serious matter to alter our old and well-established systems of weights and measures, and such a change could not be justified unless the advantages to be gained were of such profound importance as to warrant it. We are required to consider the subject in all its bearings and its manifold relations to the needs of every element in the community. The fact that our present systems, especially as they apply to weights and measures of capacity, are inconsistent and incongruous, is not alone sufficient reason to entirely abandon them. If this alone was the only objection, we could readily remove the imperfections, whilst retaining the fundamental units, but we are required to consider not only internal economy and convenience, but also international relations with the rest of the world.

"The metric system of weights and measures has outlived the century, and a review of its extension and growth indicates that it is gradually but surely superseding the ancient systems throughout the civilized world. The English-speaking people so far have not accepted it in their commercial methods. Nevertheless, we find the system is intrenching itself both here and in Great Britain, and while it has not yet had any popular recognition here, it is probably only a question of time before we will realize that we have in existence a dual system of weights and measures.

"It will be observed that hitherto the most earnest advocates for the adoption of this system have been found among professional or scientific men, or those who are required to make extensive or laborious computations. On the other hand, manufacturers and merchants have either been indifferent or been opposed to a change. The reasons for this are self-evident. The chief advantages of the metric system lie in the correlation existing between its fundamental units. This harmony of relations tends to facilitate computations and largely reduces the strain on the memory in arithmetical calculations. Evidence obtained from those who are constantly required to make extensive computations by both methods, indicates that a large amount of time would be saved for computers if the computations were based upon the metric system instead of our own existing system. It is probably no exaggeration to state that one-half the time of the average computer would be saved in technical and commercial calculations, if made according to metric units. The saving in the time of the computer is not the only economy, but we should consider also the facility with which one can retain in memory the fundamental elements of the system. It is probable that the large majority never attempt to memorize entirely our own system of weights and measures, but keep hand-books convenient for reference. On the other hand, as a personal experience, although I rarely have to use the metric system, when I do apply it I find I have a clearer comprehension of it in my mind than I have with many of our own tables of weights and measures. It is probable that a very considerable proportion of the strain on the school child would be relieved if it dealt with metric units in the study of arithmetic and its applications.

"If we had to consider the subject solely from the workshop point of view, for its convenience in linear measurements, etc., I would then say we need no change at all. I can see no reason why we cannot use our inch or foot just as well as we

could use any subdivision of the meter. A disadvantage of any decimal system arises from the fact that it cannot be continuously subdivided in halves; but this is only one point of view, and in all such cases we have to balance advantages against disadvantages. It is frequently urged that the popular mind does not instantly or readily grasp a decimal subdivision. This is largely a habit of thought, and our experience with our decimal currency tends to disprove it. I am sure that the conceptions of 25, 50 or 75 cents are not more readily grasped by the ordinary mind if we designate these sums as ¼, ½ or ¾ of a dollar.

"The objections sometimes urged against the metric system that its units are inconvenient for practical application, that the meter is too large and the millimeter too small a unit, are not conceded by those who habitually use this system only. On the contrary, it is claimed that the millimeter is a more convenient minimum unit for the ordinary every-day service than either our one-sixteenth or one-thirty-second of an inch; the former being too large and the latter too small for convenience on hand scales. Any decimal multiple of the minimum unit, varying from the millimeter to the myriameter, can be used as the base unit, according to the magnitude of the measurement involved, and these different units are readily interconvertible by a simple mental process or by the transposition of a decimal point, in marked contrast to the inconvenience found in converting our linear units of inches, feet, yards, fathoms, rods, chains, furlongs, miles, and several other units of length, which are all more or less used in special applications.

"Of late years we find many strenuous advocates of the metric system in the ranks of our manufacturers, mechanics and merchants. I think this spread of opinion arises from two causes: first, the great increase in late years of our interchange of products with foreign nations that are now using the metric system, and hence the growing realization of the necessity for an international system of weights and measures. Secondly, the large amount of computation connected with all business enterprises in modern times. The amount of computation that is now made in connection with manufacturing enterprise is much greater in proportion to the product than it was at any former time in the world's history. This is owing to all business being conducted on a more scientific basis than heretofore, and the amount of specialization is vastly increased. Take our steel works, for example; men still in active life recall the time when no chemists were employed in connection with our steel industries, and but few, if any, technically trained engineers. Results were arrived at by shrewd, skillful men, trained to habits of close observation, and the work that was accomplished was wonderful, considering the limited precedents that guided them. These men, like the architects of old, 'builded better than they knew.' Now we find our workshops and offices filled with men who have been thoroughly trained in the applied sciences. The work they perform is the result of laborious calculations, from which the elements of chance are eliminated as far as possible. To these men any system of metrology is a great desideratum, which results in a saving of time or needless labor; and in the ranks of these you will find the strongest advocates for the adoption of the metric system.

"The strongest objection that is usually raised against such an innovation as herewith proposed, is the confusion and large expense involved in the change. It is true we will have to endure some temporary confusion, but the amount of expense necessarily connected with the change is probably much over-estimated. It is usually assumed that if we are called upon to apply the metric system of measures in our manufacturing establishments, the immediate result would be the replacement of large quantities of tools, especially of gages and measuring devices that are made to conform to these gages. The fact of the matter is, to the workman the unit of measurement, so far as fine subdivisions are concerned, is a nominal distinction. He works from gages the dimensions of which originate in the tool-room. So far as rough measurements are concerned and where the hand-rule is used, it can make but little difference to the workman what unit of measurement is adopted. He can soon readjust his thoughts and acts to suit any system. If called upon to adopt the metric system in any establishment under my control, I would make no immediate change in any of the tools, but use them as they are, merely denominating them in the nearest convenient metric unit. For example, call an inch 25 millimeters, and so on with any multiple or subdivision of the inch. It would be urged against this that there is no correspondence between the absolute and nominal dimensions of the tool. This, although very desirable, is not absolutely essential; in fact, in many of our tools, the dimensions are only nominal and not exactly real. It would be desirable, however, to begin to make new gages and tools to replace the old ones as they were worn out. These could be made of actual dimensions to correspond closely with the nominal. The consequence would be that workshops would have for a period two standards, the old and the new; the old applying to all existing products and designs, and the new tools to be applied to new designs and products. The former would gradually disappear and the latter would in time entirely take their place. The manufacturer simply would maintain a double standard —all named in metric units—the one gradually disappearing, to be replaced eventually and entirely by the new standard. Many shops at present have two or more standards of dimensions in service, between which they have to preserve distinction, and it would simply require some extra care to prevent confusion or error.

"The subject of screw-threads is also frequently quoted and the difficulty and confusion that would result if we were to attempt to change our present system. I may ask, in reply, why change it at all? If it is good, retain it as it is indefinitely. The pitches of screw-threads are entirely arbitrary and the difference could be denominated by the letters of the alphabet or by any other distinction that is desired. The workmen produce these screw-threads by the change gears of their lathes, or by special tools that are furnished them for the purpose, and it is matter of indifference to them from what unit of measure they are derived. If in the course of time a revision of the system of screw-threads should be desirable, they might then, as a matter of consistency, be based upon metric units; but until such a contingency occurs, there can be no object in making any change.

"The opponents of the metric system frequently attempt to stifle it by ridicule. When the Stone Bill was before Congress, a few years ago, a rather humorous speech was made by one of the members that caused considerable amusement, and it was claimed that it had some effect in bringing votes to the opposition. A system, however, that has endured for a century and received as wide acceptance as this, cannot be silenced by an epigram or disposed of with a sneer.

"The foreign sound to the names is objected to. If the meter or the kilogram or the liter are not considered euphonious or acceptable, I am sure it is easy to translate them into desirable terms. 'A rose by any other name would smell as sweet.'; remembering, however, that terms or expressions that are uniform in all languages would facilitate very much international understanding and convenience.

"An article published by a noted mechanical engineer of New York attempts a similar form of argument by imagining a child sent to the grocery to purchase a kilogram and 850 grams of cheese, and questioning the effect of such a demand upon the parents and the grocer. That was simply trifling with the subject. If we stop for a moment and reflect that a gram is a very fine subdivision of weight, more strictly comparable to the grain than to the ounce, wouldn't it be equally absurd for a child so instructed to ask the grocer for a pound 10 ounces 6 drachms and 20 grains of cheese; or if in search of some commodity the druggist dealt in, to ask the latter for a pound 6 ounces 5 drachms 2 scruples and 6 grains of his commodity? Would not the merchant be at least as much astonished by the latter requests as the former in the metric measures? Arguments of that kind are very funny, but not logical. If the metric system were in vogue for the ordinary pur-

poses of life, we would do just as the French and Germans do. We would speak of the halves and quarters of the meter or the kilogram or the liter, just as we do with our decimal coinage, without any inconsistency.

"The gentleman who preceded me* criticised the millimeter as being too small a unit for popular convenience on hand rules. This doubtless depends upon the point of view. To many others the millimeter appears to be a very convenient minimum unit. Our ordinary rules are usually divided into sixteenths of an inch, which is too large a minimum unit, and the half of this, or the thirty-second, is rather too fine a subdivision for ordinary rules. From a broader point of view we might state that if the matter of the units of subdivisions on rules, or facility of measurements, or convenience of workshops, were the only questions involved, we do not need to make any change, our present system is good enough. But we must look further; we must consider the army of men who make our computations, burdened as they are with our incongruous systems. Also the convenience and economy of those who are engaged in the world's commerce. We desire to facilitate international trade relations and remove all the barriers that we can with consistency, to permit international exchanges. If an international system is to be sought, we surely cannot expect those who have discarded their ancient systems and adopted the metric standard to drop this and take up our heterogeneous methods. By reading the report of the committee you will observe that no compulsory measures are proposed or suggested. It is not probable that any system could be forced upon the community, against the popular desire, by any legislative enactment, and yet the very nature of the case implies that to make it effective it must be adopted by all; there can be no half-way measures in connection with any system of units, in which the members of the community have to deal with each other, any more than we could have several languages co-existent as a national tongue. It is quite possible, however, for the National Government, which is the largest consumer of the country, to put it in force in its own Departments; it exists already in some of these Departments. All that is necessary is to enforce it in others as rapidly as possible, without serious expense or confusion to the interests involved. If the National Government would do this, the great army of manufacturers who are supplying the national wants would necessarily adopt the system in their relations with the government. This would surely lead to its adoption in our relations with each other. The movement already has a strong following in Great Britain, and it is not improbable that the British may precede us in its adoption, and when the system comes into popular use, the only wonder will be that we so long delayed in accepting so convenient and time-saving a system."

In response to a question as to what his works would do in rolling steel beams of various kinds if the metric system were adopted, Mr. Christie said:

"I do not see any reason why there should be any change at all. I think we should simply take them as they are and give them the nearest metrical measurement. I think in time we would adopt new sections. That would come in time; but it would cost something to do it. We are making new sections and new tools all the time.

"Why should we change our screw threads because of adopting the metric system? There is not a nation in the world but what uses the United States standard screw thread. A system of metric screw threads has been proposed and may be adopted; but the reason it has not been adopted is because there is no necessity for it. We can govern that and maintain our own, and keep to the present standard. We do not need to change the present standard of screw threads."

S. M. Vauclain, superintendent of the Baldwin Locomotive Works, was also a member of the committee, and being called upon for remarks spoke, in part, as follows:

"So far as the metric system is concerned from a manufacturer's standpoint, it certainly should have no terrors. Where—in what workshop—can you find a dozen men who will measure the same piece of work and find the same result with the ordinary 2-foot rule, or such scales as are ordinarily provided for their use? Could any manufacturer in America to-day rely upon the accuracy of the measurement of its employees in its product? Instead of having first-class fits and interchangeability he would have first-class misfits and ruination of his trade.

"We have a moderately large workshop; employing some 11,500 men; our work is very much in detail; the first-class locomotive of to-day requires 13,000 separate pieces, all accurately made, before that locomotive can be turned out on the track as a finished product; and if we stop to consider that five finished locomotives of this kind are turned out every working day in the year, it can readily be understood how poorly these locomotives would be fitted together if we relied upon each and every one of these 11,500 men to do the measuring necessary to fit these parts together with the drawings furnished by the draftsmen in their hands.

"What is the natural procedure, then, in a workshop of this kind? You receive the drawings from the drawing-room; they are all made to, we will say, the English measures—12 inches to the foot, 3 feet to the yard, or whatever you please—no matter how you may see fit to speak of it; but really and truly these drawings are not made to the ordinary English measure; they are made to a scale which is adopted, and which represents 12 inches to the foot, or 3 feet to the yard, or so many sixteenths inches to an inch. The scale that we have adopted in our drafting-room is a scale of 2 inches to the foot, and in comparing everything that we look at, we do not consider the foot at all; but if it is 2 inches long it is a foot long.

"Therefore, is it not apparent to anyone here that if these designs are made according to the metric system, it would be just as easy for us to judge of the size of an article by the dimension on the metric drawing as it would be upon the drawing that is made to conform to our present system of measurement? Granting that that is the case, and the drawing is placed in the shop, the holes are marked the nominal diameter; we will have an inch hole marked upon the drawing, 1⅛-inch hole, or 1¼-inch hole. Now, do we put 1¼-inch holes or 1⅛-inch holes in this work? Not at all; the holes are almost any size. These sizes are governed by a set of standards which is adopted by the workshop for the bolts that are to fit in those holes; and in order to get a tight-fitting bolt we are not foolish enough to undertake to fit a straight bolt in a straight hole where several straight holes come one above another in several pieces and expect to get a good fit all the way through; we adopt a taper bolt the nominal diameter of which is 1 inch, or 1⅛, or 1¼; and when the hole is drilled it is drilled the nearest size to the smallest part of the reamer which is to pass through that particular piece; and then the pieces are reamed to a set of standard gages and never measured at all. I doubt, if you would go through a workshop containing 300 or 400 men, whether you could find a dozen first-class 2-foot rules in the establishment, and a steel scale has grown to be a curiosity. Of course, a steel scale is necessary; but it should be in the standardizing department. Where these scales are compared and seen to be of the proper size, and where all the calipering gages for turning work to proper diameters are made and corrected, the use of a measuring stick (and a 2-foot rule is nothing more than an ordinary measuring stick) is merely to approximate the diameter. The pair of calipers will be set probably within a sixteenth of an inch for the rough cut; but the finishing cut is always calipered or measured with a positive gage that is furnished by the measuring department or those who we suppose know how to measure.

"Some few years ago I was not inclined to favor the adoption of the metric system, and I cannot say to-day that I am in favor of it. We can get along with the ordinary foot. It doesn't make any difference, particularly, how long a foot is, so that everybody uses a foot that long. We could just as well get along with the meter. It

*Geo. M. Bond, of Hartford.

makes no difference whether the meter has a positive length; that can be determined accurately by scientific measurement. The meter might just as well be 40 inches long, or it might be 36 inches long; it doesn't make any difference so that that meter will be divided by a decimal system. We think that it would probably be much more convenient than the system we have now of dividing up the foot, which we now use; and, feeling that way about it and the adaptability of any system to the workshop, I really have no objection to the adoption of the meter.

"It resolves itself into this: that in the scientific world of to-day—a world that we did not enjoy thirty or forty years ago—those of us who have lived more than fifty years will remember when we were boys and going to school we did not have and we were not compelled to learn those things which the average boy is compelled to learn now before he can start out into the world to undertake to earn a living; we had very little electricity—very little, indeed; we were just commencing to know something about it; and when you come to talk about telephones, about the economical consumption of steam, and a dozen other very important matters that are absorbing the public to-day, you will wonder what we did have to study when we were boys.

"Furthermore, it seems to me that we can look upon this matter somewhat in this light: if we were to go to Germany—any one of us—to start a workshop, we would not undertake to start it on an English-speaking basis; we would learn the German language, and we would do our business in German. Now, if we are going to adopt the metric system, all we will have to do will be to learn to think in the metric system. You can go in this city to-day to a school of langugages and in a few weeks learn to speak almost any foreign language sufficiently well to enable you to get along. I have known men who have been able to master enough of the German language in three weeks to get along splendidly in Germany. How is this done? This is done simply by the professor or teacher compelling the party or person who desires to acquire a knowledge of the language to stop thinking in his own language and to think in the language that he is going to adopt, or temporarily adopt. When he is compelled to think in that language, it is a very easy matter to teach him to speak in that language; and therefore, instead of making our articles 4 or 3 feet long, we would make them a meter long, or a meter and a half long; everything that we would make we would think about in accordance with metric sizes and metric dimensions.

"The gentleman from the Pratt & Whitney Company* did not enlighten us fully or sufficiently well to give us an opportunity to give proper weight to his remarks. He failed to tell us how expensive the change would be. He said that it would be expensive; he said that it would be troublesome, but did not tell us how expensive or how troublesome. When a change of this kind would commence in any manufacturing establishment, it would first commence in the drawing-room (because unless the drawings were made in accordance with the metric system, the men in the shop could never work to it), and there would be very few gages in use in the shop that would ever have to be changed, because the gages do not depend upon the figured dimensions on the drawings; the drawings would all be figured for the gages. A certain gage would be called for instead of a certain dimension. In our works to-day there is not a single hole drilled in a connecting rod where the straps are fitted on the stub ends of the rods, that is drilled to a dimension; the drawings do not refer to any dimensions; we have no use for dimensions, but we have for gages. They are marked to be drilled with a certain gage and a certain bushing piece. You could not use a 1¼-inch drill in a 1⅛-inch bushing. Whatever bushing you use determines the size of drill that you are going to use; and whatever gage you use determines the distance apart the holes may be and the number of them, and the distance they are from the end to the stub. The workman goes ahead and drills regardless of consequences, in accordance with the gage that is ordered on the drawing; and the result is that these parts are perfectly interchangeable, and hundreds and thousands of these parts are duplicated from time to time and shipped to almost every country on the face of the earth, and that without a single dimension, either metric or English, on the card—simply the gage number calling for that part. This may be met with the remark that those people who do not do their work with gages would not find it so easy to change; but that is easily confronted by stating that no first-class shop, or any shop, no matter how small it might be, that desired to enter into competition with the world, would ever do its work in any other way and expect to succeed; it would die a natural death sooner from the mere fact that it failed to use gages or jigs for the output of its work—even though it had only one of a kind to make—much sooner than it would if it undertook to use the metric system."

Mr. Bond, whose remarks were referred to by the speakers, had preceded them because he had to leave the meeting early. His address was against the adoption of the report and presented the arguments against the adoption of the metric system as strongly as they can be presented. We do not make room for his remarks only because we have, previously, in the form of letters from Mr. Bond and otherwise, printed the gist of them.

*Geo. M. Bond.

The Making and Use of Simple Dies.

BY PETER CHIAMPON.

I will endeavor to show here a number of dies that are invaluable for use in the average machine shop, especially the jobbing tool shop. The dies shown are the most simple and inexpensive of their class for work of the kind shown. Fig. 1 is known best among die-makers as an emergency die—that is, a punch and die for producing a small number of blanks of a given shape and size, of which the blank *X* is an example.

The die *A* consists of a piece of 5-16 inch flat tool steel planed and fitted to the bolster, with the shape of the blank worked out at *B B*. In dies of this kind, when only a small quantity of blanks are to be punched, the clearance or taper of the die from the cutting edge is considerable, as the more clearance given the less work and skill required to finish, allowing the blank to just fit at the cutting edge. This die is hardened and drawn. For the punch a cast-iron holder *C* is turned and finished and faced flat and smooth on the front. The punch *D* consists simply of a piece of ¼-inch flat tool steel worked out and sheared through the die and left soft. It is then hard soldered to the face of the holder *C*. For punching blanks from thin sheet metal to the number of 10,000, this die is all right. Although some may say "a botch job," the results will be found to be all that is required. This style of die is used universally in almost all of the fancy sheet-metal goods houses, as the number of different shapes, and the small quantities required necessitate the elimination of all unnecessary expense.

The die shown in Fig. 2 is known as a shearing or finishing die, for heavy blanks and is used for finishing work such as is often done in the milling machine, or grinder. The blank *Z*, as will be seen, is a small handle punched from 7-32 inch mild steel. In punching for heavy blanks the punch is always fitted very loosely to the die, and the blank produced is generally concave at the edges, and has a ragged appearance where it has cut away from the rest of the stock. To remove these defects and marks, the blank is sheared through the finishing die, Fig. 2, when trimming or cutting off a shaving of stock all around the blank leaves it smooth and gives it an appearance of having been milled. In making dies of this kind one of the blanks that has been punched is taken and filed and finished all around the edges, removing about .003 inch of stock all around. The blank is then used for a templet for finishing the die, letting it through from the back and filling the die straight, with just the slightest amount of clearance, being sure to have the blank a good fit at the cutting edge. The inside of the die is then finished and polished as smooth as possible at *G* and then filed taper downward from *H*. *I* is the gage plate which is worked out and finished to

allow the rough blank to fit nicely within it. The plate is fastened to the face of the die by the screws *J*, and the dowels *K* so that the blank will rest on the face of the die *I* with an equal margin all around for trimming. Great care should be taken in adjusting this gage plate to its proper position, as the small amount of stock to be trimmed will not allow much leeway. The die is hardened and drawn to a light straw color and the face is ground and oil-stoned, leaving it as sharp as possible. The punch is constructed in the regular way and fastened with the pad, as shown. The punch is sheared through the die and left a snug fit within it, after which it is highly polished and finished and left soft. In use, the blank *Z* is placed within the gage plate *I*, and the punch descending it is sheared into the die at *G*, trimming and finishing it all around, and, if the die has been polished, leaving a nice smooth finish, though of the simplest design, is a great tool for accomplishing by inexpensive means results that generally involve considerable time and cost. The die shown is for finishing square holes that have been punched in strips of ¼-inch flat machine steel. *W* shows the holes after the first operation and *Y* the appearance after being finished. Of course, they could be finished by broaching, but the punch shown is the best by a long shot. After the holes have been blanked they are ragged and uneven at the edges. They are also left undersize about .003 inch.

The punch *S* is first finished on the miller to a perfect square of the size required—that is, .003 inch larger than the blanked hole. After being polished, the face is finished dead square and the edges are left sharp. The punch is then hardened and slightly drawn. The die *P* is then made and worked out until the point of the punch can be entered, and then using it as a broach, forcing it into and through the die, leaving it an exact duplicate of its shape. The die is then filed taper from the back, leaving it straight about 5-32 inch from the face, as shown at *P*. After the holes for the dowel and stripper screws are let in the die is polished, hardened and drawn slightly. The edges of the end of the punch *S* are then ground and rounded, so as to enter the hole in the stock easily. The stripper *Q* consists of a piece of ¼-inch flat machine steel with a channel milled down through the center, in depth and width sufficient to allow the strip of steel within which the holes are punched to pass through it freely without side play. A small pin projecting above the face of the die *P* at the left side acts as a gage for locating the holes true with the die. The punch and the die being set up, the strip is inserted within the gage or stripper plate *Q*, with the first hole under the punch. The punch descending and entering the hole gradually compresses the metal and finishes it, leaving a dead square hole with a nice smooth finish on all sides. The punch shown should enter the work for a full inch of its length. This style of die can be used for finishing a large variety of different shaped holes in heavy iron or mild steel, where they are all required to be of the same size and shape; also leaving a finish that it would be impracticable to accomplish by other means.

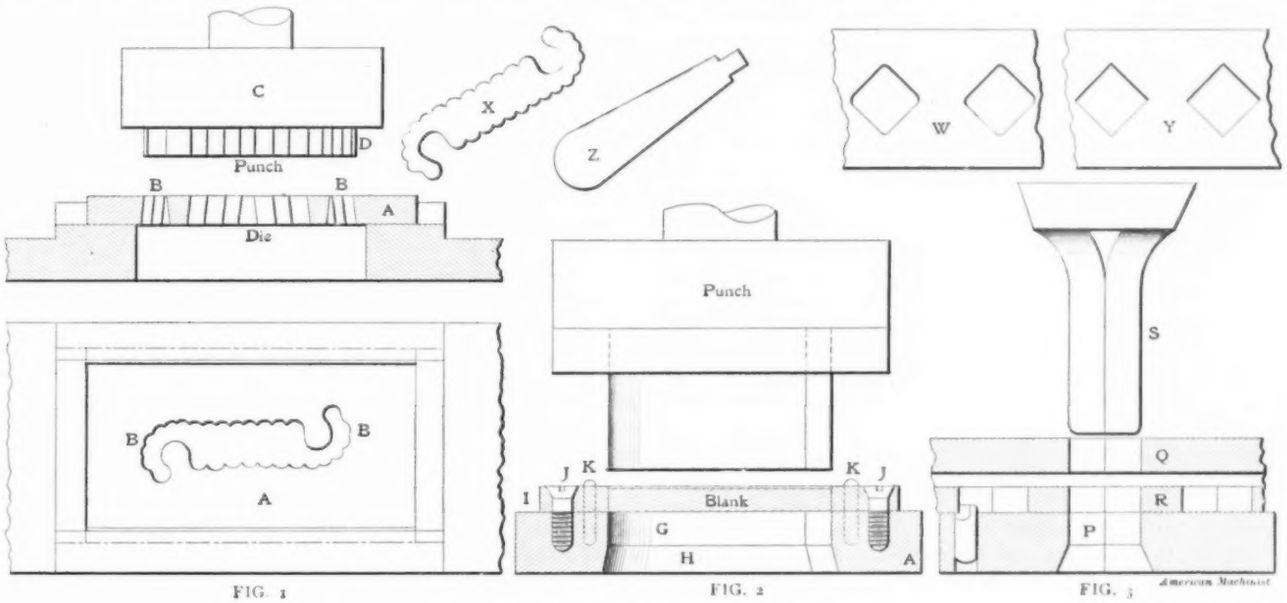


FIG. 1 FIG. 2 FIG. 3

SOME HANDY DIES FOR THE MACHINE SHOP.

producing as good a job as could be done more expensively in a miller. A large number of different small pieces in demand in the average machine shop, when the quantity permits, could be finished at a greatly reduced expense by this means.

When a nice polish or finish is desired on the work, the blank is forced through a second die, which is relatively the same as the one shown in Fig. 2, except that it tapers slightly from the cutting edge, being about .002 inch smaller at the back than at the cutting edge. This die also is highly polished and finished, and left very hard. By being forced through the die, the metal around the edge is slightly compressed, and polished by the friction. I have seen blanks treated in this manner that had all the appearance of having been polished or buffed. This die is known as a burnishing die, and is a "hummer" for quick and cheap production.

The punch and die shown in Fig. 3, al-

Some Points in Jig Design.

BY L. O. DANSE.

I am often astonished at some of the views held by people in positions which would seem to make their opinions worth considering. For instance, only a few weeks ago a manufacturer of very ingenious automatic machinery assured me that feet were utterly useless on drill jigs, and, moreover, that they were a nuisance, as they were in the habit of getting into the slots of the drill press platen. Now, this man is unquestionably an ingenious mechanic, and I would have been more astonished at his views than I was if I had not heard the same opinion expressed by others whose position in the mechanical world seemed to me to warrant their knowing better.

A drill jig needs feet because it is scarcely economical of time to brush all the chips off from the drill press platen every time the jig is handled. A footless jig will be constantly getting cocked up by chips and either break drills as a result or else drill holes in such a manner that the work is not interchangeable; and what is a jig good for if it doesn't produce interchangeable work?

Right here let me digress a moment to call attention to the peculiar ideas some

people seem to have regarding the meaning of the word interchangeable. For instance, a well-known manufacturer of automobiles proudly boasts that he makes parts, not by the dozen but by the thousand, and that they are all interchangeable; yet I noticed that the grinder hand had a lot of cylinders about and was grinding each piston to fit a particular cyilnder, marking and keeping them paired up. Now, according to my understanding of the word interchangeable, a thousand cylinders would be bored to limit gages and a thousand pistons turned and ground to their limit gages and all of them be thrown into stock and then assembled indiscriminately, and every one would be a fit.

It is a common idea that such accurate work is too expensive for regular diet; but there could not possibly be a greater mistake, as the cost of producing this degree of accuracy, because of the saving it brings about on the erecting floor in doing away with the cost of trying and fitting, is vastly less than by the opposite method.

I once took charge of a shop whose owner complained of the fact that while his machining costs were decreasing, the erecting cost continued about the same as it had been years before. I promised to bring it down and started in to do so at once by compelling a most careful observance of the limits in machining and by introducing changes in the jigs so as to secure parts which would go together without trimming. Mr. Jones kept worrying over the question "Why don't you start changing things around on the erecting floor?", but I didn't pay any attention to him and simply went on reducing the erecting cost by getting things finished before coming on to the floor instead of after.

We have strayed from our subject, which was feet on drill jigs. The objection that they are apt to get into the slots of the platen is easily disposed of by making them a trifle larger than the width of the slots. If a chip gets under a foot a trifling movement of the jig is sufficient to get rid of the obstruction, while a chip under a footless jig usually requires the raising of the jig to brush it away.

Many people in designing jigs construct them like a box, totally hiding the work. This is bad practice, as the more open a jig is made the greater the facility of putting in and taking out the work and of observing the behavior of the work while being operated on.

The work should never be supported by plane surfaces in direct contact with it, as chips and even dust adhering to these surfaces very frequently prevent the correct location of the piece being operated on. The best form of locating surface is a rounded, button-shaped pin, as this shape is always wiped clean by the slight movement of the work which necessarily takes place in locating it.

Whenever possible locate on three points to avoid rocking. Get the locating points as close to the holes to be drilled as possible, consistent with safety from damage by or to the drills, and if possible between the holes and the edge of the piece rather than on the inner side of the holes, as this precaution reduces the chances of springing the work by the presure of the drills. If you need more than three points of support, use spring plungers for the balance, arranging so that each plunger can be securely held by a set-screw after being brought into contact with the work. Always clamp directly over the rigid points of support, if possible, as by this means springing the work is prevented.

Round surfaces can be held in V's in many cases. When it is convenient to do this, it is well to cut away the surface of the V in such a manner as to secure two points of support on one leg of the V and one on the other.

Don't ever use jackscrews for supports as they will inevitably be left too high sometimes and cause springing or rocking of the work.

Don't think that because three locating points give the best results three legs will do the same, as a three-legged jig might be riding on a chip without its being discovered, while one with more feet will betray the presence of chips to your "feel-sight."

Where successive operations are to be performed on a piece, arrange all the jigs to locate at exactly the same spots on the piece, or you will probably find variations in the results.

Bushings, locating points, plungers and clamping screws are better and more easily made from machine steel, case-hardened, than from tool steel.

Loose bushings should have a projecting pin to catch on a dowel in the jig and prevent their turning, as this prevents wear of the hole in which they are located.

Make your jigs rigid, but don't forget that they must be handled and should not be unnecessarily heavy.

Milling Machine Chart.

Mr. Robert H. Lachmann, of 4818 Columbus avenue, Chicago, has sent us a blueprint copy of a very useful chart containing an index table for compound indexing (by the original method using two rows of holes) giving settings for all divisions up to 357, which cannot be obtained with the regular plates supplied with the Cincinnati milling machines. The chart contains also tables of other data which are needed daily about a toolroom milling machine.

The article at page 1318, entitled "Progress in Gas Engines and Gas Power," was written by W. H. Booth, of London, and its publication anonymously was due to an oversight superinduced by the vacation season.

Letters From Practical Men.

Roller Bearings.

Editor American Machinist:

Your editorial comment at the end of Mr. Eveland's article on roller bearings, at page 1168, was correct; the real cause of roller bearings having the rollers cut through the cage ends is not because of the "weak point," as he stated, but because true alinement was not obtained by the manufacturer of all the parts going to make up the complete bearing. I have known instances in which the cage was filled with balls instead of rollers and still the hole was milled through the end of the cage.

If there is a very slight taper to the sleeve on which the rollers travel, when the load is applied the rollers are forced toward the end of the bearing which has the greater opening and will drill or mill a hole through the cage ends. The same action takes place when the rollers are slightly tapering as well as when the inside of the outer shell in which the rollers travel is slightly tapering for the same reasons, and this is where the trouble will most often be found, as it is much more difficult to grind the long internal holes perfectly true and straight with the usual grinding fixtures supported at one end only.

It may be interesting to know that the form of bearing illustrated at page 1168 was patented in 1898 and was intended to be used for end thrust purposes as well as for carrying the radial load. It did not succeed for that purpose, and a later patent was taken out in 1901, in which the ball feature was used only to prevent the rollers from wearing through the cage ends. The only practical difference between it and Avery's patent, taken out in 1883, was that Avery used pieces of leather instead of balls and called them anti-rattlers, but they really served the same purpose, because, by the time the pieces of leather were worn out, the ends of the rollers had become so highly polished that they could not wear themselves through the cage ends and the rollers had become adjusted to the service required. Pierce's patent in 1868 and Lynch's later one of 1870 are on the same lines, except that they put the pivot as a fixed part of the roller. The fact that they were before the days of the automatic screw machine and the grinding machine made them appear crude compared with what is now placed upon the market, but they gave good satisfaction where they were used.

The latter day inventors of roller bearings have followed more the forms and types exhibited by Avery and Lynch, especially in cage construction, on account of the cheapness of making, while the designers of higher grade and more substantial bearings similar to the Mossberg roller bearings have patterned after the forms patented by Burnap in 1867.

The whole trouble with S. Y. P.'s bearings was the result of errors in journal alinement, making too tight a fit and wedging.

The Hyatt roller bearing, properly put in service and properly cared for, will give as good satisfaction as any on the market and show the same ratio of limited friction as mentioned in Mr. Eveland's table. Engineers do not, however, care much for those statements in the present state of the art. We all know the practical value of roller bearings, well made and in their proper place, but, unlike patent medicines, they are not good everywhere.

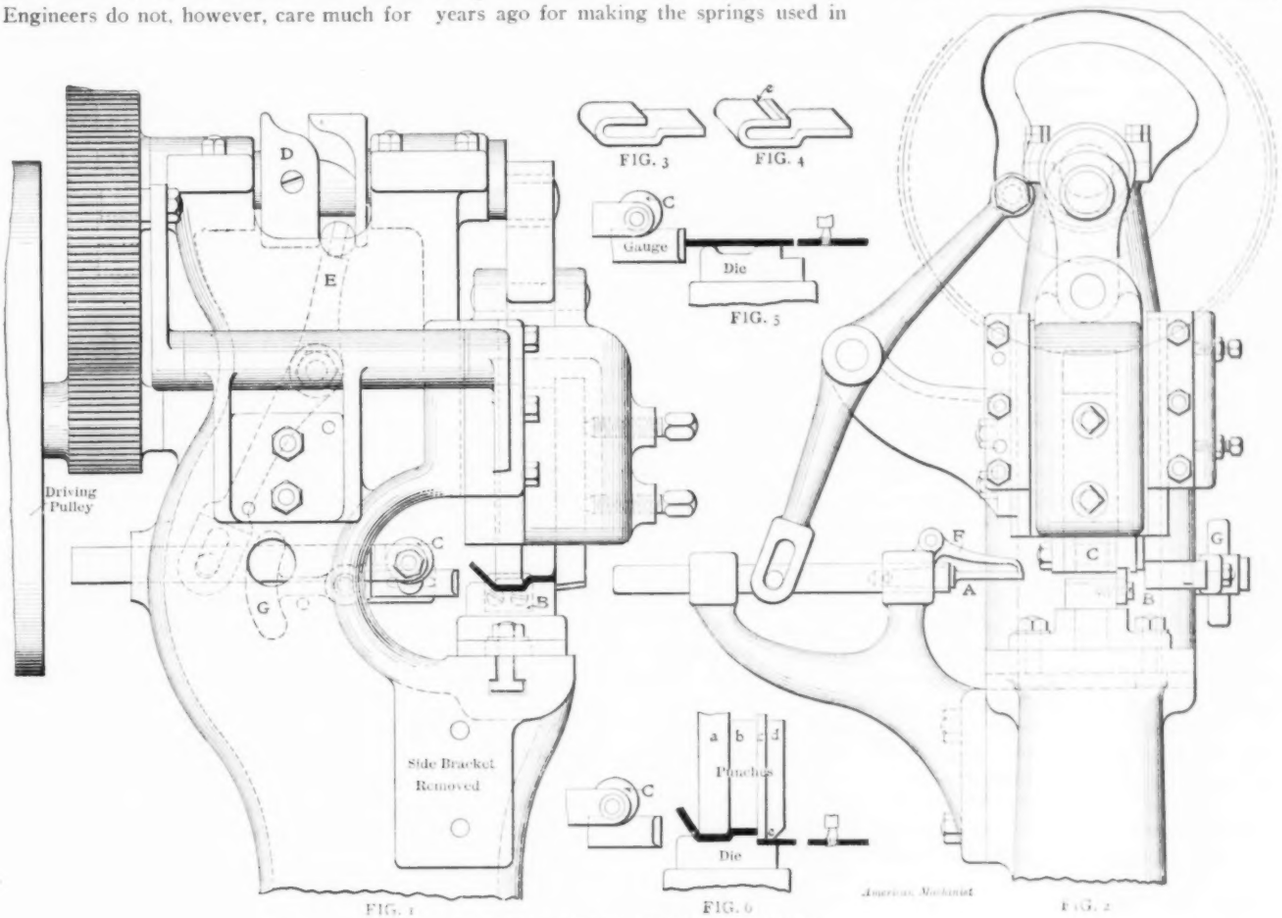
W. S. ROGERS.

A Special Spring Forming Machine.

Editor American Machinist:

The accompanying drawings show the general construction and method of operating a machine which I designed some years ago for making the springs used in shuttles to keep the cap holding tongues in position, and for other work of like nature. The machine is capable of being used for ordinary light stamping simply by putting out of operation the two cams. Figs. 1 and 2 are respectively side and front elevations of the machine. Figs. 3 and 4 are representations of the springs made, and Figs. 4 to 8 show the various operations involved in their manufacture. They are made from stock bar spring steel.

I believe the drawings are sufficiently clear to make an elaborate description unnecessary, and an account of the various operations will give sufficient details of construction.



A SPECIAL SPRING FORMING MACHINE.

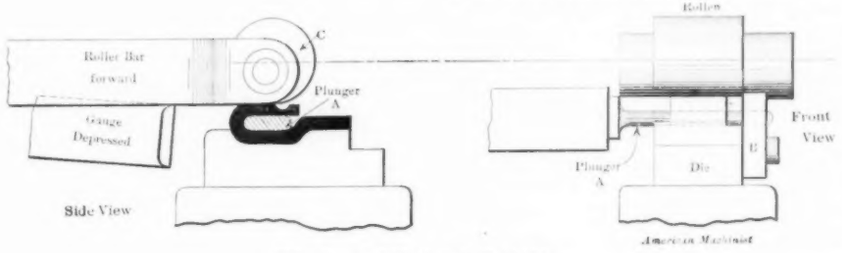


FIG. 7. BENDING BY ROLLING.

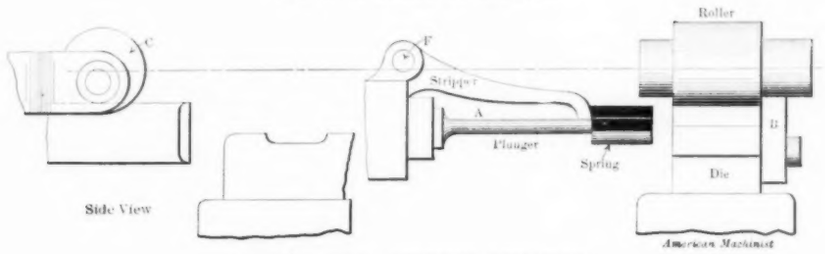


FIG. 8. FINAL STRIPPING OPERATION.

The machine is shown arranged for making springs like Fig. 3, but as the making of the Fig. 4 style of springs involves the description of a rather interesting feature, I show this class in the sketches from Figs. 5 to 8.

Spring steel bar, heated to a sufficient temperature, is thrust in up to the gage as shown in Fig. 5. The punches, etc., now descend, forcing the steel into the die, cutting off the stock by means of the shear *c*, Fig. 6, and pressing the groove *e*, Fig. 4, into the end of the stock left, as shown in Fig. 6. The punches, it will be noticed, are made in separate pieces to facilitate repairs, grinding only being necessary to put them in good order.

The punches now retreat and at the same instant the plunger *A* is passed over the work, as shown in Fig. 7, the end sliding into the keeper *B*, in order that the roller *c* in advancing, by the action of the

cam *D* through the lever *E*, within the body of the machine may not in its motion press it out of position. The roller in its forward motion rolls the upward projecting part of the partly formed spring down upon the plunger, as shown in Fig. 7, and immediately upon its retreat the plunger is withdrawn, carrying with it and upon it the red-hot spring of which it is stripped upon the spring meeting the hinged stripper *F*. The process is now repeated, the bar, however, being turned over to bring the semi-circular groove *e* to the correct position. Motion is given to the side stripper by a cam cut into the face of the large gear. It will be noticed that the gage is hinged to allow of the passage of the roller which depresses it. Upon the return of the roller the gage rises by means of gravitation through the weight *G*. The roller itself is eccentrically fixed to allow for adjustment for different thicknesses of work and to permit also of a little latitude in making the dies.

Immediately underneath the stripper is fixed a sheet-iron shoot by means of which the hot springs are precipitated into water and hardened. To temper them they were "blazed off." Of course, the capacity of the machine as regards quantity was limited by the ability of the operator, but we expected an output of about sixty per minute, as against about ten to a dozen by hand processes.

To heat the stock, natural-draft fires were employed, the sizes being only ½x⅛ inch to ⅜x3-16 inch. I might say that at each heat three to six hinges were made, and two to four bars, according to the size, were kept going a a time.

FRANCIS W. SHAW.

Birmingham, England.

Bracing up a Shop.

Editor American Machinist:

When I read "Dutch's" wail about the unsatisfactory state of affairs in his shop I was tempted to write an immediate reply, but decided first to hear what some of the other brethren had to say, and I am glad to acknowledge that some of the ideas advanced have broadened my own views.

A few years ago I had a little experience in that line myself, having been engaged by a plate-glass manufacturing firm to act as master mechanic at their plant. The plant had originally been built by people who were not practical plate-glass makers and had failed, being then bought in by a new lot who were equally ignorant of the business. The original company, seeing that they were on the road to a sheriff's sale, had run the machinery to destruction without attending to the repairs required to keep it from falling to pieces.

The new company engaged a man to take charge of the machinery who was a good mechanic, but lacking in some of the traits essential to success in that place. Finding that little or no progress was being made toward continuous and economical operation of the machinery, the company engaged me to go to the works and relieve this man.

The conditions I found were discouraging in the extreme. The polishing department sounded like a hammer shop. The engines were filthy and pounding themselves to pieces. The grinders were in bad shape and their pits flooded. I walked out to the machine shop, which I found in what had once been a district school building. There were two rooms, one occupied by the lathe, planer, drill press and pipe threader, not to mention a wabbly old grindstone. The other held two smiths' fires, the engine and a vise bench.

Between the machines in the "machine shop" (save the mark) was a miscellaneous collection of stock and scrap, including some new cold-rolled shafting, which had to be climbed over to get through the place, and everywhere was dirt, dirt, dirt. In the smith shop there were no hoods or stacks over the fires and here was another accumulation of stock, scrap and dirt. Behind the machine shop an addition had been built, two stories high; the lower for a stock room, the upper for a pipe-fitter's shop. The latter had been abandoned as the fitter had a new one-story shop near by. Both these rooms held a curious mixture of stock and scrap. The upper room could only be reached by an outside stairway. The outlook was certainly discouraging, but I immediately made my plans and lost no time in putting them into execution.

First, I got a couple of laborers and had them take all the scrap out of the machine shop. Then we picked up the stock and distributed it between the rooms behind. Next I had the carpenter build a good vise bench and some lockers in the machine shop. When he finished that I had him build an inside stairway to the upper back room and fit it with bins for a stock room, while the lower one was fitted up as an office for me. Then I ordered vises, files and drills, and made a place for everything; wrenches being kept on racks on the wall, drills in a cupboard, lathe and planer tools on suitable tool boards. Galvanized pans were put under the lathe and the pipe machine. The electrician put up a lot of new lights. Stacks and hoo s were put up in the smith shop and a rack built for material.

When I found a sledge without a handle I sent it to the carpenter, together with a handle to be fitted to it. When I found a monkey-wrench in the same predicament I sent it to the smith to fit with a pipe handle welded on.

When Billy Bayliss neglected to hang up a wrench I made him walk all the way from the polishing room to the machine shop to hang it up, right in the middle of a repair job he was on. When Charley Towne made a bad fit of a flange coupling I sympathized with him. When he spoiled a couple of piston rods I suggested that he would probably be more careful in some other shop and consented to give him his time with my best wishes. When Harry Brown laid off for a drunk I didn't let him finish his week after it. When I noticed any negligence of any kind I pleasantly suggested the undesirability of that sort of thing. I never scolded, nor swore, but quietly insisted on obedience to all of my unwritten rules.

New men took the places of those who failed to satisfy me, and th older hands told them that I was a good boss so long as I was obeyed and warned them that they had better regard my requests as imperative orders, because I would "rather fire a man than chew the rag." That reputation saved me lots of trouble, its moral effect acting as a deterrent from many a breach of discipline.

I introduced time cards and took pains to show the men how to make them out; and those time cards also had a good moral effect. I set a good example in the matter of order, and made the men feel that they ought to try to please me as a personal friend. Although I used some liquor at home I absolutely refused to enter a saloon, and discouraged all the men from all forms of "sportiness." If a man was sick, I looked him up. At the same time I maintained a degree of dignity which made them all address me as Mr. Danse, although they had never been accustomed to addressing my predecessor by any other title than "Bill."

"Dutch" might have avoided his troubles if he had started aright. Now he has a hard problem to deal with. He will have to make some change in himself before he succeeds in making one in his men. At this distance it is hard to tell what the trouble with him is; but he somehow lacks the ability to influence his men. It may be a natural lack of firmness on his part, or it may be an artificial one due to ill health. It may be that he has a way of saying irritating things that make the men indifferent to his wishes. It may be that he fails to set a good example. He may exaggerate so that the men discount his words.

One thing is sure; putting up notices not only would not help matters, but would aggravate them by creating an antagonistic spirit among the men. Another thing is, that whatever the remedy, it must not be expected to work unless it is applied continuously and constantly. Keeping everlastingly at it is the secret of success in discipline as well as in other things.

Another thought has just struck me. Do the owners do their duty in the matter of providing proper facilities for doing the work, or do the men work with a feeling that the firm is handicapping them and that it isn't worth while to put forth their best endeavors?

The subject is a broad one, and there is much to be said on it; yet it is questionable whether any of us can help "Dutch" very much after all. L. O. DANSE.

Detroit, Mich.

The D'Auria Air Compressor.

Editor American Machinist:

I have long been ambitious to invent an air compressor, something new and wonderful and, like a certain water wheel once tested at the Holyoke flume, having an efficiency of 115 per cent. (Fact, this statement was made in the maker's catalog. I cannot swear to the exact percentage, but it was considerably over 100.)

In searching for similar devices already on the market which I might conflict with when my ambitions should be realized, I came across the D'Auria compressor, described at page 661, Vol. 24, by Mr. Morris. It is decidedly the most remarkable machine I found in my search, and I would like to find out how its most remarkable feature impressed some of your other readers. Generally, when anything of this sort comes out, they are inclined to discuss its merits, but in looking over my files I cannot find that the D'Auria compressor was even touched upon.

It is certainly a machine of exceptionally handsome design, one which doesn't give a fellow a feeling that he would like to whittle it down in some places and tack on it in others, but where every part seems to be just about right for what it has to do. This is a quality that makes any piece of machinery look handsome to mechanical eyes, and without it no machine is likely to be more successful than that Gothic bird cage typewriter whose frame was designed by a celebrated architect of World's Fair fame.

While I cannot pick any flaws in the general design of the D'Auria compressor, I am wondering if the fundamental principle on which it is based, the "hydraulic compensator," is really much more of an improvement to an air compressor than a Gothic frame is to a typewriter. Mr. Morris certainly gives some pretty convincing statements as to its smooth running, but as he does not give the address of the makers and I have not been able to get a copy of their catalog and study into the matter I shall have to admit I see no reason why a given weight of moving water confined in tubes should have any greater effect on smoothness of running and general efficiency than an equal weight of iron, perhaps in the form of a flywheel, moving at the same velocity. The cuts show the area of the compensator piston to be four times the sectional area of the water passages, which increases the speed of the water column to that amount and gives it a corresponding leverage on the piston when it is helping the latter out on the last part of its stroke. At 340 strokes per minute, the speed at which it was running when Mr. Morris was able to balance a 5-cent piece on edge upon it, although it was not bolted to the floor, I should look for considerable water friction in those curved passages.

Mr. Morris tells us that in the larger compound machines, weighing 46,000 pounds, the work done is equal to that of a crank-and-flywheel compressor whose flywheel alone would weigh 45,000 pounds. If my assumption as to the relative efficiency of the water column and flywheel is correct, this size of the D'Auria compressor must be handling 45,000 pounds of water, or some over 5,000 gallons, so I must be off the track somewhere.

If there is any particular advantage in the reciprocating motion of the water column over the rotary motion of the flywheel, certainly a reciprocating counterbalance of iron can be easily arranged, and if it were connected to the piston rod by a 4:1 lever connection, why would it not have precisely the same action as the column of water? I should expect it to have considerably less working friction than the water column with its extra piston and rings and, by shortening the length of the machine, make it stronger for a given weight of frame.

If this reciprocating counterbalance, of either water or iron, is the correct thing, why have none of our locomotive designers given it a trial? I have always understood that it was the excess of counterbalance in the drivers over what was needed for the connections alone that made an engine pound hollows in the track at high speeds and ride with a motion comparable to that of a "racking" horse. If the D'Auria theory is correct, the weight of the connections only should be counterbalanced in the drivers and that of the cross-head, piston, etc., might be taken care of by a "hydraulic compensator" or some other form of reciprocating counterbalance.

The elimination of this faulty counterbalancing was one of the principal points claimed for the Heilmann electric locomotive, a machine which generated its own current as it went along from a dynamo driven by a high-speed engine with two cylinders placed, if my memory is correct, crosswise of the frame. Perhaps by the time anything of this sort gets a chance for a practical test the steam turbine will have relieved us of all our trials in connection with counterbalancing reciprocating motion as far as engines are concerned, but in the line of air compressors there doesn't seem to be much to show in rotary machines, at least for pressures above what is needed to blow a furnace or a church organ.

Most of the compressors used in this section are of the belt-driven type, and, in spite of their two heavy flywheels, they are very hard on driving belts. There is no question about finding a good market for such a machine as I spoke of at the beginning of my letter, even if the efficiency does fall a trifle below 115 per cent.

E. R. Plaisted.

[The reason why the weight of the water in the compensator of the D'Auria compressor is so much less than the weight required in the flywheel of the usual type of machine is, as we understand it, that the motion of the water is stopped at the end of each stroke. In other words, the entire stored energy of the water is available for completing each stroke of the machine, whereas with a flywheel only that portion of the energy which is represented by the comparatively small loss of velocity which is permissible in passing the center is available for that purpose. We do not know whether the weight of the water is considered as part of the weight of the machine or not. As an operative machine it is part of it, but it costs nothing and does not have to be transported, neither of which can be said of a flywheel. Considered as a machine to be bought, shipped and paid for, the water is not part of it. We believe that Prof. D'Auria did considerable work on the idea of a reciprocating mass of iron before arriving at the hydraulic compensator. We are not acquainted with all the reasons which led to the device finally adopted, but perusal of the article referred to will show that the water compensator possesses a valuable safety feature which the mass of iron does not. The compensator piston has a number of slots so arranged that in case the piston, for any reason, should over-run its intended length of stroke, a by-pass will be opened and the compensator piston will be relieved of the pressure due to the moving water. The smoothness of running is due to the fact that in one leg of the water passage the water moves in one direction, while in the other leg it moves in the opposite direction, the combined inertia displacement effect of the water being *nil*. The reciprocating parts tend to displace the machine, but they are light and, moreover, the law of acceleration and retardation is more favorable than in crank machines. In the latter the acceleration and retardation are at a maximum at the end of the stroke where the speed is at the minimum, whereas with the D'Auria machine they are more nearly constant, and hence have a less value than the maximum of the crank machine. The machine was made by the I. P. Morris Company, of Philadelphia.—Ed.]

Tempering a Chisel.

Editor American Machinist:

A patternmaker gave me a wood chisel, saying he had no use for it. The chisel was made from a ¾-inch file, about 8 inches long, all ground and polished and the edges beveled the same as an ordinary wood chisel, with the exception that it was a little hard for wood work. I drew the temper over an alcohol lamp, and after the drawing it made a fine tool. The man who gave it to me saw me using it and asked me how I drew the temper and kept it so straight. "Why," said I, "I just drew the temper about 1 inch on the end." Said he, "I wish someone would give me a good kick. I spent ten hours grinding three files, and I thought they would be

no good unless I drew the temper full length, and I got them so crooked I could not use them." Said I, "That is one of those *little tricks* I saw in the AMERICAN MACHINIST." EASY.

Welding Copper.

Editor American Machinist:

I beg to differ with your statement at page 1227, and say that copper can be welded in a common blacksmith fire. I have some samples I made myself, and this is how it is done. The best compound for this purpose is a mixture of 1 part of phosphate of soda and 2 parts of boracic acid. This welding powder should be strewn on the surface of the copper at a red heat; the pieces should then be heated up to a full cherry red or yellow heat, and brought immediately under the hammer, when they may be as readily welded as iron. For instance, it is possible to weld together a small rod of copper which had been broken. The ends should be beveled, laid on one another, seized by a pair of tongs and placed together with the latter in the fire and heated. The welding powder should be strewn on the ends which after a further heating may be welded so soundly as to bend and stretch as if they had never been broken. It is necessary to carefully observe two things in the course of the operation: First, the greatest care must be taken that no charcoal or other solid carbon comes in contact with the surfaces to be welded, so have a good, clean fire. Second, as copper is a much softer metal than iron, the parts cannot offer any great resistance to the blows of the hammer; they must therefore be so shaped as to be enabled to resist such blows as well as may be. It is also well to use a wooden hammer. For fuel use charcoal. Of course, a gas furnace is better and cleaner, but with the fire a little practice will be all that is needed. F. G. EMMELMANN.

Editor American Machinist:

In reply to your request for information as to welding copper, I will say that I have made welds of ¼-inch copper rods in a boiler furnace, also the shop blacksmith did the same in the forge. The way I did it was to heat the two ends to the melting point and press them together, not hammering the joint at all. I do not know whether you would call this welding or burning, but the union of the two pieces seemed to be perfect. It was only done to satisfy our curiosity as to whether it was possible. ENGINEER.

[We have received a number of communications in which the writers tell us as above of having welded copper. It is apparently unnecessary to print many of them. We append, however, an abridgment of an account published in 1889 of the welding of copper at Sibley College. This was accomplished by Mr. Granger, the instructor in blacksmithing at the institution referred to, and the account was written by Mr. Rufus Anderson.—Ed.]

"Copper being a comparatively soft metal, even before it approaches the melting point, would seem to be capable of welding without any difficulty, but the obstacle met with is undoubtedly the oxide that forms rapidly when copper is highly heated, and with the ordinary fluxes as generally used by the blacksmith there has been little or no success in producing a weld, because the common fluxes treated in the ordinary way will not produce a fusible slag of the oxide of copper. The flux that Mr. Granger used was composed of several substances intended for another purpose but proved to be excellent for copper welding.

"To determine what were the welding ingredients of the mixture the writer prepared various mixtures of the constituents of the original flux, and we concluded that the yellow prussiate of potash was the principal one, and that a mixture of one part of the yellow prussiate with from twelve to twenty of borax was all that was necessary.

"The greatest difficulty met with in copper welding, especially with small pieces, was that, owing to the great heat-conducting power of copper, it was very hard to keep the heat long enough when the pieces to be welded were taken from the fire and placed on the cold anvil.

"The writer suggested that he use a nonconducting substance to pound on, such as a hard brick. The result was very satisfactory, and indeed he states that he finds it almost indispensable in the success of the operation, rendering it as manageable as iron welding.

"To prepare the compounds for use, it is well to heat the ingredients separately, sufficiently to drive off the water of crystallization, after which they should be pulverized and thoroughly mixed. In this way time and flux are economized, for if applied without this preliminary preparation the boiling and sputtering that take place when they are applied to the hot metal, require time for them to become reduced to the fused, glassy state, and much of the material is wasted. The addition of a small amount, about 1 to 20 of the mixture, of rosin seems to be good, as it melts at a much lower temperature and serves to hold the composition together until it becomes fused. The welding powder should be strewn over the metal at a red heat, repeating the operation several times to insure a thorough coating; then heat is continued until it approaches a white heat, when the metals may be welded by pounding with a light hammer, striking with light blows and placing the metal on a non-conducting substance instead of a metallic anvil.

"In using fluxes containing phosphorus compounds, care should be taken that the metal does not come in contact with charcoal or free carbon in the fire, as copper phosphate is liable to be formed and prevent welding."

German Technical High Schools and Company Management.

BY B. ESMARCH.

There has been much praising of German technical education. The technical colleges, more rightfully called universities, of this country especially, are considered stupendous institutions. I do not today intend to disparage their great importance, but I wish to treat of certain influences they bring to bear upon the economical development of manufacture. To say it at once, I am afraid that these splendid schools are, although in a very indirect way, responsible for much of the backwardness and procrastination in factory methods and equipment on which much comment has been made.

Perhaps it might not be amiss to give on some future occasion the natural history of the German technical schools in all their degrees and shades. For the present I will only say that in the following I refer solely to the high schools proper, the technical equivalents (at least officially) of the time-honored classical universities. It is mostly the graduates of these high schools whom companies prefer to employ as technical leaders of their establishments on account of their supposed higher erudition and better social standing. A good deal has been done in recent years to render the principles of tuition at these schools more in accordance with practical aims, but there is still far too much of the old spirit of scientific conceit, to which students with a pronounced practical turn of mind fall victims. To put it short: there is too much mathematics, or rather, the mathematical food is dispensed with too little discrimination as to individual digestions. What the schools—not the technical ones alone—too often ignore is that the capacity to grasp mathematical notions is a special faculty of brains of a certain organization, and this faculty may be partly or nearly absent with persons otherwise quite clever or even ingenious. It is similar to the presence or absence of the musical sense. Unquestionably mathematics of a high order is necessary, for instance, to the bridge designer. It follows that nobody without that mathematical sense can, or should, become a bridge designer. But one who is not so gifted, may yet become a good machine-tool designer, as mathematical theories play a part in only a few special branches of that line. But the technical high school imposes upon the student with an inventive and practical, but non-mathematical, mind the same amount of analytical lore as upon the budding bridge builder who takes its revealings as a sponge takes the water. With such students, therefore, the high school work assumes more or less the character of a wasteful process, and its product, for which, as I said, the industrial companies are customers, is likely to be deficient, and in the following the question dealt with is how the companies might in this regard be better served by the schools.

As elsewhere, limited liability companies in Germany are controlled by a board of directors—here called "supervising counsellors"—as a rule consisting of bankers, lawyers, works owners or managers of some other concern, who must hold shares, but who are not in any other way associated with the company, at whose premises they are indeed rarely seen. Their occasional sittings are indeed sometimes held at some distant and to them more convenient place. This council appoints the managers proper, who are called directors. Some works have only one director; very often there are two, one for shop superintendence, the other for the commercial business. Very large works have even more directors, and then one of them is the general (or real!) director. By far the majority of regularly made-up companies, however, have the system of *two co-ordinated directors, a technical and a commercial one.* Now the fact I wanted to come to is that, as a rule, there is more antagonism between two such functionaries than is good for the interests of the company. The commercial manager almost invariably plays first fiddle. His position is secured to him by his control of the safe. It is natural that the dealings with the board pass through him, and he thus gains full influence with the latter, especially as the board as a rule is mostly composed of commercial men. Such a board will, in the choice of a commercial director, be guided only by the purely commercial qualities of a candidate, such as the gift of securing custom, etc. No doubt this is a safe way to insure business. But if—as is very often the case—such an astute merchant is without any notion of technical principles, then it is only too probable that he will come to loggerheads with the technical manager. The merchant, from his first day with the company, thinks of nothing but his balance sheet at the end of the business term. The weekly pay-rolls, the invoices for materials are loathsome to him, and expenditures for improvements are very gall and wormwood. It is sometimes astonishing how shortsighted and narrow-minded an otherwise high-minded and up-to-date commercial manager may be found when he has to deal with questions of shop economics. With such a man his colleague, the technical manager, is necessarily in a continuous fight. Every new acquisition proposed by him is regarded with a most suspicious eye, and elaborate reports are demanded from him, of which every figure is scrutinized and difficulties are raised about points that form part of the very creed of an engineer. Such things of course are felt to be disgusting and disheartening; but matters become worse if, actuated by a morbid anxiety that things may be carried on in a wasteful manner, the commercial colleague develops a meddlesome character and finds himself called upon to pry into the methods and procedure of the shops, or if he harrasses the technical manager with propositions for savings, of which the other knows that they mean a penny-wise-and-pound-foolish policy. Even if the technical director succeeds in out-arguing his colleague a feeling of resentment remains, for it must be remembered that the technical director is not merely a superintendent and that he has not to obey orders, but is supposed to be on a par with the other manager, and may, if he thinks fit, veto the latter's measures, eventually appealing to the board. But what a life he would have of it! In most cases it is not one man he would have to fight, but a coalition of counting-house officers. Generally there is, besides the two directors, a sort of sub-director, called the "procurist"—a chief clerk holding a proxy by power of attorney, who signs for the firm and, in the absence of the commercial director, takes his place. The latter is of course prone to dispose of current business with the procurist only, who thus becomes his right hand and ally against the works' director.

If anybody should hold that I have painted too black a picture, I would say that, of course, there are instances to be found of perfect harmony reigning in a management; but the above is drawn from life, and far and wide may be heard from German engineers the wail at the thraldom of the commercial managers who are accused everywhere of impairing the initiative of creative minds and of robbing them of the greatest blessing a man can have—that of knowingly turning all his strength to the best purpose. Such a condition of things supplies also a further explanation of the backwardness of many shops, which therefore should not necessarily be taken as the result of the backwardness of their leaders. The true commercial manager likes best the shop that is dirtiest and offers the least comfort, for cleaning and handy installations cost money.

Now, the saddest of all this is that it cannot be helped—at least not until our technical high schools conform to certain alterations in the shaping of the engineers they are turning out. Among them are, indeed, wonderfully accomplished specimens; but the excess of mathematical training seems too often to have wiped out the sense for a businesslike application of their profound knowledge. Cursed as the typical commercial director generally is by the operative forces, he will yet show a dividend where many a purely technical man with all his genius would fail. Our eminent designers, our energetic and sprightly works engineers, are so wedded to their science, they go about their work so much like true artists, for its own sake! That is very ideal, but it isn't business and may lead to occurrences such as was experienced last winter, when an old-established motor works, which, laboring under the general depression, was just at the critical point, but was expected by everybody to ride out the gale, went down of a sudden, and the ensuing investigation revealed an extraordinary waste of funds, just when capital was most needed, on experiments in developing a new article which the leading engineer had believed would save everything.

By no means all our scientifically trained engineers are of the idealistic type. A large percentage of the profession are employed as so-called engineer-travelers, and many of these are excellent canvassers and procurers of orders. Their talent is in all probability also existant in many of their colleagues in the shop, but mostly in a latent stage requiring development. What gives the merchant his preponderance in German works is not so much his commercial spirit as his *craft*, by which I mean his knowledge of the details of the counting-house, foremost the safe handling of many sorts of bills; then his readiness to read from account books what just bears on the case in hand, and, last not least, the practice of having at his fingers' ends the various modes of payment and of credit-giving, and the application to a given case, which faculty secures that self-reliance and composure so essential for securing orders and settling difficulties. But all these are more or less technicalities, and I do not see why the average engineer could not be brought to master them as well as the merchant, to whom he will in most cases be superior in intellect. However, the engineering student makes a mistake who expects that these things will, as it were, be blown into him by the air of business. He must bring with him a solid stock of positive knowledge of those details, just as does the clerk. He must learn these things during the time of learning. There is no palpable reason why the colleges should not provide for them, not in the off-hand manner in which it is actually done here and there, but in the same exact disciplined way in which, for instance, statics are taught. In compensation one or the other over-taught mathematical specialties may be dropped. The young engineer who knows that he can *handle the tools of the merchant* will soon grasp the broad principles of commercial management. Let our technical universities turn out mechanical engineers to whom a bill with half a dozen endorsements is not an Egyptian papyrus, and the sovereignty of the merchant in our industrial establishments will be broken and Germany will soon rival America in up-to-date appliances and methods, in the well-being of workingmen, and in the genuineness and sterling worth of her products.

Berlin, Germany.

Removal of the American School of Correspondence.

In order to carry out the scheme of co-operation with the Armour Institute, the American School of Correspondence, heretofore of Boston, will, we are informed, be removed "root and branch" to Chicago.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 716,000 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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Technical Schools, Commercial and Technical Men.

The very striking article in another column by Mr. Esmarch calls for more than passing notice, especially as Germany is not the only country which suffers from the conditions which he describes so graphically.

The relation between the business and the mechanical manager of a manufacturing business is one of the most difficult in the world to put upon a satisfactory basis. Whether, as in Germany, they are supposed to be equals in authority or, as in this country, the business manager is recognized as the superior, makes but little difference. The supposed equality of the German technical director cannot exist in fact, as our correspondent shows it does not. Authority over the cash box is the supreme authority, and responsibility for the financial results for which all commercial enterprises are conducted is, in the nature of things, bound to confer such supreme authority.

The real difference between German and American conditions we believe lies in the absence of class distinctions here, which, we think, acts to largely break down the spirit of aloofness with which commercial and technical men naturally regard each other. In other words, we believe (possibly because we like to believe it) that there is a more "get together" spirit here than elsewhere, which leads to a degree of real co-operation that is impossible without that spirit. The commercial man here, if he has eyes in his head, simply cannot have that lofty disdain for the technical man that he too often seems to have in Germany. Dotted all over this country are conspicuous examples of successful mechanical enterprises which were founded and are conducted in every business sense by mechanics, while alongside of them are other examples of similar enterprises, conducted by business men, which are not such shining examples of success. We believe that the experience of this country demonstrates that in a manufacturing business done on a small margin of profit and in which success depends upon cheapness of manufacture quite as much as upon success in making sales, the business man, as a business manager, is hopelessly handicapped by the mechanic having the added good sense and judgment which comprise the chief items of the business man's equipment. The mere business man cannot even select a mechanical superintendent nor tell a good one when he has him. He dare not trust any judgment but his own in matters involving large expenditure for equipment, and in such matters his own judgment has little value.

We do not wish to imply that the mechanical superintendent here rests on a bed of roses. We believe that the fundamental conditions are better here than elsewhere and that, in the grand shuffle which comprises life, men more often find their level, but that many mechanical managers have to deal with the sickening conditions described by Mr. Esmarch is as true here as in Germany.

Of the tendency of our technical schools to overdo things—especially mathematics—and to create stratification by raising their standards of admission so high as to shut out all students except those from the high schools, we have often spoken in these columns. In the past the schools have been saved from doing much harm by their students, who, coming from all walks of life, have largely nullified the tendency to which we refer, and this influence still exists in spite of the efforts of some of the schools to destroy it. Some of the schools still encourage the presence of boys from the shops, and some teachers, as we personally know, recognize that in such boys is the best possible timber from which to make engineers.

The tendency of the schools to cultivate what our correspondent so aptly calls "the spirit of scientific conceit" has also been largely nullified by our social organization. It is not here, as it is in Germany, a mark of social degradation to "handle iron," and a shoppy interest in shoppy things is not considered a mark of an inferior mind. With all that may be said against the school shop and its methods, it cannot be doubted that it at least helps to prevent students from holding that contemptuous view of shop men, methods and processes that characterizes many of the graduates of German schools, and that, to some degree at least, it stimulates interest in such things. The bare fact that shop practice holds a conspicuous place in the courses of the most pretentious engineering schools makes it impossible for any right-minded student to look upon the shop with contempt. If the school shop does no more than this it justifies itself, though this is but a trifle compared with what it might and ought to accomplish.

Stationary Fire Engines.

To judge from what seemed to be the most approved ideas that prevailed at the recent convention of Fire Engineers in New York, a change is likely to take place in methods of fighting fire, which change will have considerable effect upon the machine business. The most advanced opinion seems to be that the fire engine drawn by horses to the scene of the fire will soon be retired and that its place will be taken by stationary pumping plants equipped with steam pumps and pumping through pipes laid underground into stand pipes, from which the water will be taken by lines of hose. The idea is to place the pumping plants sufficiently close together to thoroughly protect a city, and Edward Atkinson among others believes that, by this method, general or large conflagrations can be made practically impossible at a cost which will soon be made up by

the saving of fire losses and lessened cost of insurance.

The present steam pump manufacturers build pumps specially adapted to fire service, and many manufacturing plants have such pumps installed. If the portable fire engine is eventually to be replaced by such pumps, will the present builders of fire engines, who are united, undertake to compete with the pump builders, most of whom are also within a general organization?

Test of a 300 Horse-Power De Laval Steam Turbine.

We have received from the De Laval Steam Turbine Company a report of a test of one of their 300 horse-power turbine dynamos, which test has been made by Dean & Main, of Boston. From this we give below some extracts, including summaries of the results:

"The power of the turbine depends upon the number of nozzles in action, and these nozzles can be opened or closed by a hand wheel on each. The machine tested had twelve nozzles, but seven gave the rated capacity. It will be seen from this that the turbine is capable of great overloads.

"Regulation of speed is accomplished by a throttling valve operated by a centrifugal governor.

"In connection with economy of steam and the ability to throw nozzles into and out of action, it is at once apparent that each nozzle performs its function as perfectly when operating alone as when any other number of nozzles is in operation. For this reason the turbine does not change its economy of steam per indicated horse-power, if such could be determined, as does a reciprocating engine. There is no 'range of temperature' of any importance in the turbine to cause condensation of steam. The principal cause of diminished economy with lighter loads than the rated load is the fact of constant friction with all loads. At overloads there is even greater economy than with the rated load for the reasons that the extra nozzles are of maximum economy and the friction losses are constant.

"The turbine exhausted into a Worthington injector condenser, and the vacuum was measured by means of a mercury column connected into the exhaust chamber of the turbine.

"The turbine rotates very rapidly, and the speed is reduced by the employment of a spiral spur pinion on the turbine shaft gearing into one or two spiral gears, as the case may be, depending upon whether the power is desired on one or two shafts. The pinion and gears are both double, with the teeth inclined in opposite directions so that there will be no end thrust to either shaft.

. . . . . .

"No tests were made to ascertain the instantaneous effect in speed of change of load to see how quickly the normal speed was regained after a change. In regard to the permanent effect of change of load on speed, this can be observed from the data given in the tables:

"By comparing the results of the tests with superheated and saturated steam, the saving by the use of the former can be determined for the particular amount of superheating existing. As the tables show, the superheat steadily diminished as the load became lighter. This was caused by the fire and draft being very light with the lighter loads. The superheat for the eight-nozzle load averaged 84 degrees Fahr., while that for the five-nozzle load averaged only 16 degrees Fahr. There is, therefore, scarcely any propriety in making a comparison for the effect of superheat, except with eight and seven nozzle loads.

"In all of the statements made in this report of the consumption of superheated steam, the actual consumption without reduction to dry saturated steam as a standard, is given. This is customary, while with the results by saturated steam the moisture is deducted."

We should add that while the term brake horse-power is used throughout the report, the power of the turbine was actually absorbed in driving a dynamo, the current from which was consumed in driving the De Laval shops, and by a water rheostat. The rheostat was used to increase the load beyond that needed for the shop and also for steadying the load and keeping it uniform. The dynamo was independently tested for efficiency in order to determine the equivalent brake load.

Nozzles Open.	Loads.	Relative Loads.	Speeds.	Differences in Speeds.
8 nozzles.	352 H. P.	100 per cent.	750 r. p. m.	. . . . .
7 "	298 "	85 "	756 "	+ 8/10 of 1 per ct.
5 "	196 "	56 "	745 "	− 7/10 " 1 "
3 "	119 "	34 "	751 "	+ 1/10 " 1 "

TABLE OF DIFFERENT LOADS AND SPEEDS WHEN USING SUPERHEATED STEAM EXCEPT WITH THREE NOZZLES.

Nozzles Open.	Loads B H. P.	Relative Loads.	Steam per Brake Horse-Power.	Increase for Diminishing Loads, referred to Maximum Load.	Length of Run.
8	352 H. P.	100 per ct.	13.94 lbs.	. . .	6 hours.
7	298 "	85 "	14.35 "	2.9 per ct.	2 "
5	196 "	56 "	15.53 "	11.4 "	6 "
Superheated Steam.					
8	333 H. P.	100 per ct.	15.17 lbs.	. . . .	4 hours.
7	285 "	86 "	15.56 "	2.6 per ct.	2 "
5	195 "	59 "	16.54 "	9.0 "	2 "
3	119 "	36 "	16.40 "	8.1 "	3 "
Saturated Steam.					

TABLE OF RELATIVE STEAM CONSUMPTIONS FOR DIFFERENT LOADS, PER BRAKE HORSE-POWER.

No. of Nozzles in Use.	Amount of Superheat.	Load with Superheated Steam.	Load with Saturated Steam.	Steam used per Brake H.P. with Sup. Steam	Dry Steam used per Brake H.P. with Sat. Steam	Saving by use of Superheated Steam.
8	84° F.	352 H. P.	333 H. P.	13.94 lbs.	15.17 lbs.	8.8 per ct.
7	64° F.	298 "	285 "	14.35 "	15.56 "	8.4 "

TABLE SHOWING THE SAVING BY THE USE OF SUPERHEATED STEAM FOR EIGHT AND SEVEN NOZZLE LOADS.

Progress in Locomotive Construction During the Decade 1890-1900.

The following particulars regarding recent progress in locomotive construction are extracted from the Census Bulletin on Locomotives:

"During the census year 1900 there were 28 establishments the sole or chief product of which was locomotives. At these works 2,774 locomotives of all classes were built, with an aggregate value of $27,121,063, compared with 2,409 locomotives, valued at $19,752,465, built in 19 establishments in 1890. In addition, 272 locomotives, valued at $3,276,393, were constructed at 26 railroad shops, making a total of 3,046 locomotives valued at $30,397,456, built in 54 establishments during the census year 1900. The figures for 1890 do not include locomotives built in railroad shops.

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"As a result of conditions which have necessitated the practical reconstruction of the railroad transportation systems of the United States—a work still in progress and likely to continue for many years—the period between 1890 and 1900 was probably the era of most notable development in locomotive construction.

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"In 1890 a freight car with a carrying capacity of 60,000 pounds was deemed adequate for all ordinary requirements, but in ten years the limit has been increased to 100,000 pounds, while cars of even greater capacity have been constructed. This increase has been made possible through the substitution of steel for wood in the construction of freight cars. The application of the air brake to freight cars has permitted freight trains to travel with

safety at higher rates of speed than were practicable a few years ago.

. . . . . .

"All the changes mentioned, together with the demand for higher rates of speed in the passenger service, have given great stimulus to the development of a locomotive having greater tractive power and capable of running at higher rates of speed than those manufactured in 1890. The most important features of this development may be summarized as follows: A marked increase in size and weight, with increased tractive power and speed; the use of larger boilers, with thicker shells; larger fireboxes and increased grate area, made necessary by the demand for higher steam pressure and greater steam-generating capacity; economy in the use of steam, by compounding; and the substitution of steel castings for wrought-iron or iron castings for several important parts.

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"It is difficult to measure in exact terms the increase in weight of locomotives since 1890. Some figures taken from the records of a single locomotive establishment may be accepted, however, as fairly representative. In 1890 the average weight of the locomotives built in this plant was 92,000 pounds for the engine alone, exclusive of the tender. In 1900 the average weight for the same establishment, and on the same basis was 129,000 pounds, an increase of 37,000 pounds, or 40.2 per cent. Many locomotives exceeding 100 tons in weight have been constructed during the past ten years. The largest engine thus far built weighed about 133 tons, or nearly 190 tons with tender, and it is not safe to say that even this limit will not be exceeded.

"The continually increasing demand put upon boilers by the requirements of heavier traffic and higher rates of speed have brought about a continuous increase in the pressure per square inch at which steam is used in locomotives. In 1870 about 130 pounds was a fair average; in 1890, the average was about 160 pounds; within the past ten years this has been increased more than 25 per cent., and steam is now used frequently at a pressure of 225 pounds.

"To meet the increased pressure it has become necessary to use heavier steel plates in the construction of boilers. In 1890 it was customary to use plates about ½ or 9-16 inch in thickness for boiler shells, but now it is quite common to use plates up to ⅞ inch thick; at the same time there has been a marked increase in both the length and the diameter of boilers.

"With the increasing diameter and higher steam pressure, the enlargement of the firebox and the increase of the grate surface became necessary, in order to meet the larger steam requirements.

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"A comparison of the grate areas obtainable in the different types of firebox shows the following results: Restricting the firebox to the width between the frames and to a maximum length of about 10 feet, a grate area of approximately 27 square feet is obtained. Extending the width to the limits of the space between the driving wheels and using the same maximum length gives a possible grate area of about 35 square feet. In the Wootten type, with a possible width of 8 feet and a length of 10 feet, 80 square feet of grate surface can be had. The later type of broad firebox offers the same possibilities, but a length of 8 feet and a breadth of 66 inches, giving an area of 44 square feet, probably represent the most advantageous dimensions. The grate surface of a cylindrical firebox is usually from 30 to 35 square feet, but may be more, according to the diameter of the boiler.

"Probably the most important improvement during the past ten years in locomotive construction has been the introduction of the compounding principle in the use of steam. The principle is not new, even in this industry, as patents for compound locomotives were issued in the United States as early as 1846, and an engine of this class was built in 1867 at the Shepard Iron Works, Buffalo, N. Y. Compound locomotives did not come into any general use in the United States, however, until within the last decade, although many engines embodying this principle were built in England and continental Europe a few years earlier.

"The advantages of compounding, so well demonstrated in stationary engines, have attained general recognition by railroads and by the builders of locomotives, and a large proportion of the engines built each year are constructed upon this principle. During the census year 1900, 329 out of a total of 2,831 steam locomotives were built with compound cylinders.

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"Almost from the very beginning American locomotives have been radically different in their general construction from those used in Europe. It is a marked tribute to the excellence of the American locomotives, however, that in recent years they have been purchased in large numbers for railroads in England, France and Russia, where they have been put into service in competition with types of locomotives to which those countries have adhered persistently for many years. The growth of the export trade in American locomotives during the past ten years is noteworthy. In the fiscal year 1890, which almost coincides with the census year, there were exported from the United States 161 locomotives, valued at $1,280,606; while during the fiscal year 1900 there were exported 525, valued at $5,592,403.

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"The time required for the construction of a completed locomotive from the raw material varies greatly, according to the requirements of the purchaser and the conditions governing the supply of materials. While ordinarily it takes several weeks, or even two or three months, to build a locomotive, some remarkable achievements in quick work have been made by American builders, either to meet emergencies or to establish records. Eight days is probably the shortest time in which an engine has been built, starting with the raw material and constructing all the parts; but an engine has been assembled and erected ready to run in twenty-four hours."

Drawing Deep Shells.

Our correspondent, Jos V. Woodworth, wishes us to state that the tools, fixtures and presses used for producing the deep shells described in Mr. Woodworth's article at page 1338, entitled "The Drawing of Deep Shells from Sheet Metal," were constructed in the shops of the E. W. Bliss Company, of Brooklyn, N. Y. We are indebted to the above firm for assistance in showing this interesting example of their work.

Disappearing Gun Carriages Recommended.

Some time ago we referred to the fact that some of our army officers did not favor the use of disappearing gun carriages for coast defences. A board was appointed to conduct tests and report upon the value of such carriages and it is announced that this board has now made a report in which the members are unanimous in recommending the continuance of the manufacture of disappearing gun carriages for 8, 10 and 12 inch guns. It recommends, however, that no more 6-inch guns be mounted upon disappearing carriages, as the development of rapid-fire 6-inch guns has made such carriages inadvisable for them. The board recommends, further, that an increased allowance be made for gunners in order that expert mechanics may be secured to take charge of the guns and their mechanism.

Dimensions of Eye Bolts—Erratum.

Our attention has been called to an obvious error in the table of eye-bolt dimensions at page 1342. The reference letters *A* and *C* in the engraving have obviously been transposed.

It is said that nearly every person habitually puts the sock (or stocking) on the same foot first and never varies. They tell a story of one young lady, however, who was found in tears one morning because she could not decide which stocking to put on first. Dr. Holland once wrote a very interesting and valuable article about habits and their usefulness to the individual, taking the ground that a good habit once formed saved a lot of mental wear and tear—served in fact as an automatic regulator and conserver of energy. Neither Dr. Holland nor anyone else, however, so far as we know, ever wrote anything about habits that is so apt to

be appreciated and enjoyed by machinists as the article in this number under the head of "Echoes from the Oil Country." No one who has anything to do with a machine shop should fail to read it.

Employees of the Stanley Electric Company have organized "The Stanley Club," the objects of which are stated to be the consideration of employees' insurance, employees' reading room, a series of lectures for the winter months, grievances, athletics, etc. The company co-operates in the matter by furnishing a suitable place for meetings.

It is announced that the gas companies in and around the city, of Boston, have been merged, that they will turn their attention to the production of electricity for lighting, which will be made sufficiently cheap to bring it into general use, and that the present gas plants will either be discontinued or used for furnishing fuel gas only.

Miss Helen Gould has for some time been considerably interested in the work of the League for Social Service, to which we have referred and whose leader is Dr. W. H. Tolman. As an outgrowth of this league, a new organization has been formed to be known as the American Institute of Social Economy, the first meeting of which was held at the residence of Miss Gould. It is announced that the purpose of the institute will be "the collection, the interpretation, and the dissemination of information concerning social, civic and industrial betterment.

The United States Civil Service Commission announces that from October 21 to 22 examinations will be held with a view to securing a man for a position for draftsman in the Lighthouse Service at Tompkinsville, N. Y. The salary will be $100 per month. Persons who wish to compete should apply to the United States Civil Service Commission, Washington, D. C.

Personal.

Max Daunert, American representative of Schuchardt & Schütte, sailed for Germany on the 23d, and will return to New York in a short time.

Samuel O. Bartlett, for the past two years connected with the British Thomson-Houston Company at Rugby, England, arrived home recently by the "Majestic."

E. Braga, Jr., who has been superintendent for Lage Bros.' drydocks and shipyards at Rio de Janeiro, is in New York to take a post-graduate course in certain branches of engineering, especially electricity.

Obituary.

Joseph P. Weatherby, proprietor of the Camden (N. J.) Machine Works, died September 20. He had been engaged in the machine business forty years.

John Fairfield Foss, an inventor and builder of textile machinery, died at Billerica Centre, Mass., September 14, sixty-one years old. His business life had been spent in Lowell, where he was associated with John M. Pevey. He had a large number of patents, his greatest invention being the under-flat cotton carding engine. He was said to have come near to bearing the same relation to the art of carding cotton that Eli Whitney bore to the cleaning of it.

Peter E. Garrison, master mechanic of the Fonda, Johnstown & Gloversville Railroad, who died August 22, fifty-seven years old, was eulogized in a memorial adopted by the Central Railway Club at its September meeting. Mr. Garrison began work as a machinist in the Erie shops at Port Jervis, from 1880 to 1883, was general foreman of the Greenwood Lake shops, and later in a similar capacity in several other shops. He had been with the F., J. & G. road five years.

Albert F. Prentice, formerly vice-president and a large stockholder of the Prentice Brothers Company, Worcester, Mass., died September 14, sixty-one years old. Mr. Prentice was born and spent his life in Worcester. He was educated in the public schools of the city, and when quite young began to work in a trunk factory. His brother, Vernon F. Prentice, was already working in a machine shop, and by his influence the young man was brought in to learn the trade. They worked together in this first shop for six years and then started in business as toolmakers and after three months they were burned out. They did business together in another shop for over two years, when Vernon sold out to his brother, who later sold the whole to F. E. Reed. Mr. Prentice was then superintendent of the Cleveland Machine Company, of Worcester, for two years. The brothers formed a copartnership in 1872 for building blacksmiths' drills, and from this the present business has developed. The present building was erected in 1889. Four years ago the firm was incorporated and Albert retired a year later.

Commercial Review.

NEW YORK, September 22.

Perhaps at no time in the history of the country have so many industrial enterprises been incorporated as during the past year. Scarcely a day passes without information that several have come into existence in various parts of the country.

Because of its favorable corporation laws, New Jersey easily heads the list of States marking the advent of new enterprises, particularly those of an industrial character. New York has made notable progress in this respect during the past year, because of the revision in its corporation laws, which took place a little over a year ago, and which are less stringent in their provisions than formerly. Delaware, Maine and West Virginia might be said to follow in the order named.

Manufacturers of machinery evince a very deep interest in new industrial enterprises, because of the opportunity for the sale of their products they offer.

The question is very often asked if their expectations in this regard are realized. There is quite a diversity of opinion existing on this point, the major portion of which would seem to justify a conclusion in the negative. The underlying reason given is that new industrial enterprises as a general rule represent the amalgamation of concerns already in existence rather than new ones coming into existence, and that the former are already equipped with the machinery necessary for their active operation.

On the other hand, many new enterprises form an old business to be operated in the future on a larger scale, and calling for additional equipment to make this possible, thus causing some good orders for machinery to be given.

Again the fact must not be overlooked that many new enterprises practically die "a bornin'," for while certificates of incorporation are easy to obtain, it's quite another thing to get enough subscriptions to their stock to admit of a sufficient working capital.

It is a fact worthy of note that the statistics of new enterprises incorporated during the past two years show that the bulk of them bear an intimate relation to the iron and steel industry in some way, shape or form, and that these easily lead so far as an active and prosperous career is concerned.

The belief that the large importations of foreign irons to this country would eventually lead to all sorts of reports has been confirmed. The latest thing in this line is that a combination of foreign iron companies is about to be organized to combat the competition from the United States. Speaking of the reports circulated in this connection, Windsor Richards, a director of Guest, Keen & Co., says: "There is not an atom of truth in them. Such statements do a great amount of mischief. The iron trade is not very flourishing and these untruthful statements do great harm to business."

In a recent issue attention was called in this column to the first annual convention of the National Machine Tool Builders' Association which will be held next month, the date and place of which have not been set. While nothing definite has been determined upon so far as the form the proceedings will take, it is understood that particular attention will be given to increasing the membership of the association.

At the present time the membership of the association is about fifty, which, while

constituting a fair representation of the machine-tool industry of the country, does not comprise the representation that is possible.

In machinery circles the opinion is that the formation of the association supplied a long-felt want. Previous to its inception, machine-tool builders had no other means of intercommunication beyond that which trade offered.

In this particular they stood out in strange contrast to men engaged in other branches of business. For example, stock, cotton, grain, coffee, ship, metal, and wool brokers have their exchanges, which work as a unit in every scheme intended to protect or extend their particular business. The list could easily be enlarged of business men who have banded together for similar reasons. There never was a time in the history of the country when the machine-tool industry formed such a notable factor in its industrial progress as the present. The census of 1900, for example, shows, that while the actual average of men, women and children employed during the census year was only 5,316,802, the horse-power employed in all our manufactories in 1900 was equal in producing capacity to the labor of 113,000,000 able-bodied men working every day in the year.

While machine-tool builders are not the only persons to be considered in connection with these figures, their contribution to the creation of them is not to be ignored. Yet the fact remains that until a few months ago they had no organization to subserve their interests. The best wishes of the trade will go out to any attempt the National Machine Tool Builders' Association makes to increase its membership, and the hope will be universally expressed that the time is not by any means remote when there will not be a single branch of the machinery trade that will not have an organization of its own. The tendency of the time is toward centralization in all things, and manufacturers of machinery should keep up with the procession.

American manufacturers of mining machinery who do business in South Africa say they are making good headway in the disposition of the machinery which has lain dormant in their salesroom in the interval between the beginning and cessation of hostilities in that country. They expect in a short while to dispose of it all if trade prospects are as bright as they seem.

A fact of some significance in connection with the foreign machine-tool trade is found in the fact that the Berlin firm of Schuchardt & Schütte are about to establish a branch house at Liege, Belgium, though they have a branch at Brussels, less than two hours' away. Many auotomobiles are being built in the vicinity of Liege, and there is said to be a fair demand for good modern tools there.

The Eureka Fire Hose Company, of Jersey City, N. J., have decided to discard their present direct-current power transmission system and to adopt an alternating-current system, in order to reduce the cost of fire insurance where motors are used in the presence of inflammable material. This step has been taken on the advice of one of the largest insurance companies of this country. The new apparatus includes one 75-kilowatt belt-driven alternator, furnishing two-phase current at 7,200 alternations and 220 volts; also exciter, switchboard equipment, slide rails, rheostats, etc. A number of induction motors have been purchased, including the following: Five of 15 horse-power, one of 10 horse-power, five of 5 horse-power, and three of 2 horse-power. With these there will be funished a switchboard feeder panel, completely equipped with instruments and switches. The entire electrical equipment has been ordered from the Westinghouse Electric & Manufacturing Company.

The H. B. Smith Company, of No. 123 Liberty street, have received some good orders recently for wood-working machinery for installation in various piano manufactories throughout the Eastern States. They are now making improvements at their plant in Smithville, N. J., to meet their increased business.

The work on the new plant of the National Water Tube Boiler Company, at New Brunswick, N. J., is progressing so rapidly that the company will shortly award the contracts for the necessary machinery.

The new plant of the Millers Falls Paper Company, at Millers Falls, will be electrically driven throughout. Contract for the entire equipment covering generators, motors, arc and incandescent lights, etc., has been placed with Sargent, Conant & Co., of Boston.

The Northern Engineering Works, Detroit, Mich., have the contract for supplying the electric cranes for the new foundry of the American Shipbuilding Company, at Detroit, Mich. The contract consists of one 40-ton 5-motor and one 15-ton 3-motor electric traveling crane, one 3-ton electric crane and three 5-ton cranes.

The Syracuse Railroad Construction Company, which is building a 25-mile electric railroad between Auburn and Syracuse, N. Y., has recently closed a contract with the Westinghouse Electric & Manufacturing Company for two 650-kilowatt engine-type alternators, delivering three-phase current at 360 volts and 3,000 alternations; also for five 400-kilowatt rotary converters, together with raising and lowering transformers for operating a 15,000-volt transmission line to two substations. A complete switchboard is included, and in fact everything for the operation of a complete railway line.

The Link-Belt Engineering Company, of Philadelphia, Pa., have notified the trade that in consequence of "the persistently increasing cost of raw materials and labor," it has revised its price-list on link belting, for which its customers will have to pay higher prices in the future.

For the mammoth factory which the Ward-Mackey Company are erecting at Pittsburgh, the Pitsburgh Gage & Supply Company will furnish two 250 horse-power water-tube boilers. This company is also installing a complete White Star Filtering System in the power-house of the New York & Stamford Street Railway Company, Port Chester, N. Y.

The T. C. Dill Machine Company, Inc., report a good demand for their new slotter, a description of which recently appeared in this paper.

The Standard Roller Bearing Company, of Philadelphia, are preparing to go into the manufacture of steel balls.

The American Engine Company of New Jersey, through its New York representative, E. S. Boyer, of No. 95 Liberty street, has sold two 325 horse-power duplex compound engines to the Standard Steel Works, Burnham, Pa.

Among the orders recently taken by Edwin H. Ludeman, of No. 39 Cortlandt street, are the following: Three 750 horse-power Murray-Corliss engines to the Colonial Construction Company, Hudson, N. Y., and two 150 horse-power engines of the same make to the Standard Oil Company, Constable Hook, N. J.

Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has just returned from a five weeks' trip to Europe, and talks entertainingly of the business situation there. His company now owns the New Taite Howard Pneumatic Tool Company and the International Pneumatic Tool Company, of England, having recently taken over the latter company and having reorganized these companies under the name of the Consolidated Pneumatic Tool Company. The Chicago Pneumatic Tool Company owns all the stock of the three English companies, the Consolidated company being capitalized for $300,000, with A. W. Macnochie, a member of the British Parliament, as chairman of the Board. They operate factories at 138-148 Tooley street, London, and in Chippenham, Wiltshire, England, for the partial production of the pneumatic tools in Europe.

The company expects to arrange to duplicate its Detroit plant in Scotland for the production of tools required in the shipbuilding work in that country. The exhibition before the Shipbuilders' Federation in Glasgow, which has recently been concluded, was highly successful, and the pneumatic tools have practically been adopted for all the shipbuilding work in the Scotland yards. The American workmen making the exhibit of pneumatic tools on shipbuilding are now in Germany, and from there will go to France for the purpose of making other exhibits. While in France Mr. Duntley took an order for 130 pneumatic riveters for one of the largest French shipyards.

As an evidence of the growth of the

pneumatic tool business of this company, Mr. Duntley cites the fact that their sales in 1895 amounted to $8,000, while in the current year they will run about $3,000,000.

CHICAGO MACHINERY MARKET.

The opinion among Western engine and boiler men is general, if not universal, that business shows no decrease from the phenomenal volume of the past two years. In the Eastern markets steel is reported to be quieting down somewhat, but the representative of one Western engine builder says he would have no trouble in going out among the steel people and in a week closing up a million dollars' worth of orders for blowing and rolling-mill engines, could he make deliveries in six or seven months. The demand for engines and boilers has the same broad and miscellaneous character it has had for the past year or longer. The inquiry is as large and as wide as at any time in the recent past. Some little work that was being figured upon for this fall's shipments has gone over until next spring, because of unavoidable delays. There is complaint at some shops that material, especially plates, cannot be obtained from mill as fast as needed. This caused delay in getting out work. But the builders generally say they have more work than they can do. One engine builder is asking six months on even small engines, 150 horse-power, though on that size a considerably earlier shipment is promised by most builders.

Within the past few days the power for the new Lake Shore and Rock Island passenger station at Chicago has been bought. The Buckeye Engine Company secured the contract for the engine, a double-valve construction of 1,600 horse-power. The boilers will be of the Cahall type, and the Western Electric Company is said to have the contract for the generators and motors.

The contract has been placed for the boilers for the new First National Bank Building. They will be of 1,800 horse-power and be built by the Sterling Company. Wickes Bros. have sold boilers of 400 horse-power to the Riverview Coated Paper Company, Kalamazoo, Mich. The Allis-Chalmers Company has sold a 3,000 horse-power engine to the Chicago Edison Company, for installation in its old power plant in this city. The company reports business heavy, contracts taken in August having greatly exceeded the output of the shops for the month, and September showing well up so far. The Frost Engine Company says business is keeping up well in both boilers and engines. The only trouble experienced is in getting material.

The gas and gasoline engine trade is active. Fairbanks, Morse & Co. say that for the first eight months of the current year business was 55 per cent. better than the corresponding period last year. One or two makers of gas engines report, however, that within the past month there has been some decline in the trade with the farmers.

Quotations.

NEW YORK, Monday, September 22.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:	
No. 1 X	$23 50 @ $25 00
No. 2 X	22 75 @ 23 50
No. 2 plain	22 25 @ 22 50
Southern:	
No. 1 Foundry	22 00 @ 23 00
No. 2 Foundry	21 75 @ 22 50
No. 3 Foundry	21 25 @ 22 75
No. 4 Foundry	20 25 @ 21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅝ @ 11⅞c.; electrolytic and casting, 11½ @ 11¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 26 @ 26¼c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5⅝c.

Antimony—Cookson's, 10¼c.; Hallett's and U. S., 7¾ @ 8c.

Lard Oil—Prime City, 76 @ 79c., according to brand and quantity ranging from one barrel up to large lots.

Manufacturers.

Fire has damaged the Stonewall Cotton Mills at Stonewall, Miss.

The Torrey Roller Bushing Works, Bath, Me., will build an addition.

The Crookston Lumber Company will build a large sawmill on Bemidji Lake, Minn.

The wood-working plant of W. W. Harper, Charlottetown, P. E. I., has been burned.

Max Lowenthal & Bro., Rochester, N. Y., manufacturer of knit goods, etc., will build a new factory.

The Hanson & Van Winkle Company, Newark, N. J., chemicals, has plans for an additional building.

The Smith Paint & Varnish Company, of Milwaukee, Wis., will build a factory at West Allis next spring.

The Metropolitan Hygeia Ice Company is organizing and proposes to build a plant at Cambridge, Mass.

It is reported from Des Moines, Ia., that the Western Fence Company will build a factory in Davenport.

It is reported that the New York Air Brake Company, Watertown, N. Y., is about to build a large new foundry.

The Warren Manufacturing Company, of Warren, R. I., textile manufacturer, has decided to add to its mill.

It is reported that F. W. Winter, of New Gloucester, Me., a lumber dealer, will build a box factory in Auburn.

Peru, Ind., is understood to have secured new shops of the Cincinnati, Richmond & Muncie Railroad Company.

The new Kearney & Trecker shops at West Allis, Wis., are in operation, but it is intended to add to them this fall.

Hatheway & Reynolds, manufacturers of knit goods, etc., Oriskany Falls, N. Y., intend to build a new factory this fall.

The Hollinsworth & Whitney Company, of Boston, Mass., and Gardiner, Me., is about to erect a pulp mill at the latter place.

The West Allis (Wis.) Malleable Iron & Chain Belt Company will put up three or four buildings and employ about 500 men.

The foundation for a woolen mill is being laid at Amherst, N. S. H. L. Hewson will be president and E. E. Hewson, vice-president.

Contracts have been awarded for the erection of factory and office buildings for the Detroit Office & Bar Fixture Company, Detroit, Mich.

The contract for the work above the foundation on the new building for the Bigelow Carpet Company, Lowell, Mass., has been let at $128,000.

The Barker Lumber Company's mill at Burford, Ont., has been burned. The mill contained iron-working as well as wood-working machinery.

Contracts have been signed for the erection of a large new plant of the Carter-Crume Company, manufacturer of check books, etc., Niagara Falls, N. Y.

E. B. Estes & Sons, of New York, and a syndicate of Ellsworth (Me.) lumbermen have organized to establish a wood-turning factory at Ellsworth.

The factory of Pulaski, N. Y., of Charles Tolliner's Sons Company, manufacturer of wooden boxes, has been burned, throwing 125 persons out of work.

The Vermont Farm Machine Company, Bellows Falls, Vt., has decided to add to its plant a machine shop, 60x172 feet, two stories with basement.

The Cleveland (O.) Twist Drill Company has obtained a permit for the construction of a factory building, three stories, 38x127 feet; cost estimated at $10,000.

The O. S. Kelly Manufacturing Company, of Iowa City, Ia., threshing machines, etc., has been looking for a site for a plant in the neighborhood of Milwaukee, Wis.

Engineers of the Pennsylvania Steel Company, Steelton, Pa., have been at work on plans for a new open hearth steel department for the Central Iron & Steel Company.

S. G. Barker & Son, manufacturers of scales, etc., Scranton, Pa., have awarded the contract for the erection of buildings, including machine shop, blacksmith shop, etc.

The American Cabinet Company, incorporated at $200,000, is erecting a plant in Fairmount, North Buffalo, N. Y. The president is C. H. King; managing director, L. M. Hewit.

The Thomas Irvine Lumber Company, which operates a logging camp at Cherry Valley, on the Snoqualmie River, Wash., has bought a site for a lumber mill on the Snohomish River.

The contract has been awarded for removing scrap iron and other debris from the recent fire at the Portland (Me.) Iron & Steel Company's works at Ligonia, preparatory to rebuilding.

The plant of the Novelty Wood Company at Spriggport, eleven miles south of Muncie, Ind., has been burned. It was owned by John Hickman and used for making berry and cheese boxes and other wooden ware.

Finch & Campbell, of Spokane, Wash., have bought a site at Hoquiam for a $150,000 sawmill and box factory. They also become half owners of a folding box factory, to which they propose to add extensive improvements.

The Rosenthal Husker Company, which manufactures corn huskers, has part of its new plant at West Allis, Wis., in operation, but there are machine shops yet to be erected.

The Daimler Manufacturing Company, of Astoria, Queens County, N. Y., has bought land in Bayonne, N. J., fronting Newark Bay, on which it will erect a plant for the manufacture of gasoline automobiles and launches.

Work has begun on the new machine building of Clark Engine & Boiler Company, Kalamazoo, Mich., to replace the one burned. The machine building will be 50x100 feet. The boiler shop, which has just been completed, is 50x140 feet.

James J. Foley and A. M. Danbery, of Cincinnati, O., have become third-owners with William H. Ball in the Ball-Mitchel foundry at Maysville, Ky., and the new concern set sail under the name of the Maysville Foundry & Machine Company.

The Montgomery Door & Box Company, Buffalo, N. Y., has filed plans for an addition of a flourth floor to its plant. This floor space, about 20,000 square feet, has been leased to Carlton M. Lyman & Co., for the manufacture of furniture.

Claus A. Spreckles, son of the sugar king and president of the Federal Sugar Refining Company, which is said to have a plant at Yonkers, N. Y., has formed a Canadian company and proposes to build a big sugar factory at Montreal and another in or near Vancouver.

The T. B. Laycock Manufacturing Company, bed springs and mattresses, Indianapolis, Ind., has taken out a permit to build a four-story factory addition, 77x193 feet. It is intended to provide room needed before the completion of other buildings to be put up next year.

It is reported that Lee Sharp, of Omaha, Neb., has visited Plattsmouth to look over the ground with a view of moving his machine shop to that city. He wishes to install an electric lighting and steam heating plant and run this in connection with his manufacturing plant.

A swamp at West Homestead, Pa., has been filled with hot slag, which has become a solid mass. On this will be erected what, it is said, will be the largest structural and angle steel plant in the world, by the Carnegie Steel Company. An open hearth furnace will also be erected to supply the ingots.

The A. B. See Electric Elevator Company, which has a factory at 116 Front street, Brooklyn, and an office in the St. Paul Building, New York city, has bought more than eight acres in Jersey City, and will erect works there, moving from Brooklyn. The new buildings are to cost $70,000.

Robeson T. White, of Salt Lake City, the representative of an extensive iron manufacturing firm whose name he declines to make public just now, has purchased for the company the grounds of the Knickerbocker Athletic Club at Bergen Point, N. J. It is said that a plant will be built to cost $275,000.

J. R. Booth, lumber, has found it necessary to add to his plant at Burlington, Vt. A new molding mill is being erected. A new kiln is to be added. A new 150 horse-power boiler, a 600-light dynamo, with a 65 horse-power engine, are to be installed. Automatic machinery for grinding saws is to be put in.

It is stated in Brockton, Mass., that the water commissioners have been authorized to contract for engine and pumps for the new pumping station to be constructed in Silver Lake. Bids are about being advertised for. The pumping machinery will be capable of furnishing a supply of about 6,000,000 gallons daily.

Henry McCoubray, of St. Johns, N. F., has returned from New York, where he arranged to secure expert hands for a company that has been formed in St. Johns to manufacture oilskins, candles, soap and general supplies for the fishermen. The company, which will be capitalized at $50,000, will build a plant at St. Johns.

The Ross-Meehan Foundry Company, Chattanooga, Tenn., will erect a new building to be used for making bells. Some new machinery will be required in the plant. It is likely that the American Brake Shoe & Foundry Company, which bought out the brake shoe department of the Ross-Meehan Company, will also build extensions in Chattanooga.

A contract has been awarded for the construction of a new plant for the Donovan Wire & Iron Works, Toledo, O. The buildings will be four in number and will cost about $30,000. The machine shops will be 70x200; the foundry, 60x160; the pattern shop, 40x80, and the office building, 40x40. One of the features will be traveling electric cranes.

Plans are being made for an electrical plant to be erected by the Reading Company at Kissinger's dam, Reading, Pa. It is believed that enough power can be obtained from the fall to furnish the railroad company with all its lighting power in Reading and also to run the pumps of the Oley street mills, light the plants of the Reading Iron Company and run the Reading Paper Mills.

A new town, to be known as Alexton, is to be established across the river from Monongahela City, Pa. The Liggett Spring & Axle Company, of Allegheny, has purchased land and will build a plant. From 800 to 900 men will be employed. The Coshocton (O.) Iron Company also will erect a plant in the new town and will employ about 300 men. It is expected that both works will be in operation about February 1.

It is stated at the real estate office of Prior & Landrine, Jersey City Heights, that negotiations for the sale of several acres of ground are under way with a New York company, a manufacturer of nails and staples. At present the firm employs about 300 men and says that if it should decide to build in Jersey City, the new plant will be larger than the present one and the working force increased to 500 men.

Articles of association for the Vermont Light, Heat & Power Company have been filed with the Vermont Secretary of State. The company is capitalized at $200,000, and among the capitalists identified with it are J. J. Flynn and A. O. Humphrey, of Burlington, Vt., and E. E. Carpenter, of Worcester, Mass. The principal offices will be in St. Albans, where it is the intention of the organization to construct a plant to supply light and power for the St. Albans & Swanton Railroad and for manufacturing purposes.

H. W. Morris, formerly engineer of the Gibbs Electric Company and recently secretary and engineer of the Milwaukee Electric Company, has incorporated his interests with those of John Otenberger, formerly general foreman of the Gibbs Electric Company and recently superintendent of J. & J. Otenberger, under the firm name of the M. & O. Company. The new firm will locate in Milwaukee and take over the machine shop of J. & J. Otenberger and expect shortly to place upon the market a line of dynamos and motors.

Niagara Falls has been selected as a site of the American Carbolite Company, which proposes to manufacture carbide under a new process. Former Senator Towne and party came from Toronto to consider the question. On the site that is selected the Standard Carbolite Lighting Company will also erect a plant for the manufacture of the acetylene gas generators.

A story was recently printed in some of the Pittsburgh papers to the effect that a new corporation with $5,000,000 capital was being organized to erect a large steel car plant probably in that district, to operate under a number of new patents, and that a man named E. A. Nesbit was at the head of it. The story has been contradicted, and in default of corroboration, judgment as to its truth must be suspended. According to one of the reports, John W. Garland, president of the Garland Chain Company, Rankin, Pa., is prominent in the enterprise.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book, "Dies and Diemaking," 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

If you have a first-class manufacturing proposition and need a plant or capital we can assist you. Box 18, AMER. MACHINIST.

Castings and blueprints, 5 sizes boat and sta. 2-cycle gasoline engines; also completed engines; tested, successful. Hildreth Motor Co., Lansing, Mich.

Wanted—A good second-hand screw cutting lathe with 10 in. swing, complete with gears and foot power; give lowest price. Box 30, AMERICAN MACHINIST.

Wanted—A second-hand screw machine; capacity 1¼ through chuck plunger; friction back gear, wire feed, automatic feed to turret. Box 15, AMERICAN MACHINIST.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears, catalog of small tools free. R. M. Clough, Tolland, Ct.

Mechanical engineer and draftsman wishes to submit to parties interested in gas and oil engines an entirely new and simple design. Address "Unique," care AMER. MACH.

Drafting, by the job or hour; contracts made for regular work; ideas perfected; all mechanical drawing done quickly and accurately. B. & K., care AMERICAN MACHINIST.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—A machine shop and foundry of medium size in Ohio, Indiana, Illinois, Michigan, New York or Pennsylvania; give full description and lowest cash price. Box 19, AMERICAN MACHINIST.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Established, reliable New York house, interested in machinery, wishes to represent some well-known manufacturing company whose products possess merit; can send experienced technical man on the road. Address "Highest References," care AM. MACH.

For Sale—Fully developed and good-paying manufacturing business; present plant is new and up to date; best firms in the country have bought its product for past 15 years; this is a splendid opportunity; best of reasons for selling. Box 20, AMER. MACHINIST.

For Sale at a Bargain—An established manufacturing business, suitable for any first-class machine shop; easily moved; will sell for less than cost of finished stock and throw in patterns, tools and material worth as much more; worth investigating. A., care AMERICAN MACHINIST.

Foundry for Sale.—Complete plant, in Syracuse, N. Y.; will make castings up to 30,000 lbs.; is adapted for general work; has traveling crane, two cupolas, blower, flasks, etc., and is ready to run; plenty of local work; low price and reasonable terms; also

have large machine and boiler shops, same place. Wm. A. Reade & Co., 410 American Trust Bldg., Cleveland, Ohio.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Designing draftsman, 7 years' shop and office experience, wants position. Box 889, A. M.

Skilled mechanic and expert draftsman, a professional inventor, wants engagement. Box 22, AMERICAN MACHINIST.

Competent mechanical draftsman with practical shop experience desires position. Box 8, AMERICAN MACHINIST.

First-class man, designer, superintendent or assistant; engines, air compressors, general machinery. Box 2, AMERICAN MACHINIST.

Mechanical and electrical draftsman wants position with a manufacturing concern; New York preferred. Box 21, AMER. MACHINIST.

Experienced shop manager; duplicate parts; shop system and cost reducer; skillful handler of men; employed, wishes to change. Box 32, AMERICAN MACHINIST.

Draftsman and designer of electric cranes and hoists, technical graduate, 6 years' experience, wants position. Address H. R. E. S., care AMERICAN MACHINIST.

Draftsman and designer of special and automatic machinery, machine tools, jigs, fixtures, etc.; 12 years' practical experience. Box 31, AMERICAN MACHINIST.

Foreman machinist, good handler of help, hustler, with extensive experience of labor-saving methods and systems, open for position. Box 25, AMERICAN MACHINIST.

Wanted—Position as superintendent or foreman of iron foundry; practical and successful; accustomed to estimating, etc. Address R. H., care AMERICAN MACHINIST.

Superintendent of small shop, successful in handling men, experienced designer machine tools and special machinery, open for engagement. Address Box 885, AMER. MACHINIST.

Technical graduate, with 14 years' practical experience, having held responsible positions both in shop and as machine designer, wishes to change; best references. Box 1, AMERICAN MACHINIST.

Position—Chief draftsman or assistant superintendent; 14 years' experience, shop and designing light automatic machinery; also charge manufacture interchangeable parts. Box 17, AMERICAN MACHINIST.

Designing draftsman, age 32; position as assistant superintendent; technical graduate; 6 years' board, 10 years' shop experience; well up in latest shop methods; light automatic machinery. Box 23, AMER. MACH.

By live, up-to-date toolmaker in northern Pacific coast country; can give good reference as to ability to handle toolroom to advantage in plants producing medium and heavy work. Box 10, AMER. MACHINIST.

Mechanical draftsman, 14 years' experience, automatic, special and general machinery, desires permanent position as assistant to superintendent, engineer or chief draftsman; New York or vicinity preferred. Box 11, A. M.

Position with progressive firm as assistant to manager, engineer or superintendent, by first-class mechanical draftsman with experience in all departments of shop or varied lines of work. C. H., 257 17th St., Milwaukee, Wis.

Mechanical engineer and draftsman wishes to change; technical education; large experience as foreman, master mechanic and superintendent manufacturing small and medium interchangeable machinery and fine steel instruments. Box 4, AMERICAN MACHINIST.

A mechanical engineer, with long experience as machinery builder, desires to connect with a well-established machine works; can introduce profitable lines of machinery; managing position only considered, with or without investment. Box 884, AMERICAN MACHINIST.

Experienced cost manager and estimator; 30 years of age, married, of good executive ability; thoroughly conversant with all details of factory accounting, and capable of introducing or revising cost system to suit conditions; with present employers 6 years; best of references. Address Box 5, AM. M.

Position desired by young mechanical engineer (resident of New York) as respresentative of manufacturing company, traveling salesman or in charge of city office; practical experience on machine tools, special machinery and general engineering; best references; junior member A. S. M. E. "Executive Ability," care AMERICAN MACHINIST.

Mechanical engineer, 24 years, energetic, ambitious, technical graduate, 5 years' shop and drawing-room experience, good constructor and draftsman, desires to make a change for December 1, or before, and is looking for a good position, with chances of advancement, with concern near or in New York city. Offers under Box 891, AMERICAN MACHINIST.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACH.

Wanted—Position as foreman of toolroom or machine shop, by energetic young man with extensive and successful experience on tools for interchangeable work, sheet metal work and special and automatic machinery; systematic and thorough; a good manager and a hustler; designing, estimating, costs; references. Box 24, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, chief draftsman and expert designer, desires change; 8 years' experience as M. E., assistant M. E., superintendent and chief draftsman, in shop management, power transmission, power plant installation and the design of light, heavy and automatic machinery; best of references. Address Box 878, AM. MACH.

Expert in applied mechanics, able organizer and executive, wants position; no solvable problem too hard, no position too difficult; exceptionally wide experience, both theoretical and practical, and therefore qualified to exactly adapt application of mechanical processes to any material; acceptable personality; ample references; salary wanted, $3,000 or more. Box 27, AMER. MACHINIST.

Situation as superintendent wanted by young man, a designer and developer of best class of light and heavy machinery; an expert of highest abilities, as results show; will accept only a well-paid situation and will assume mechanical or business responsibilities to any extent offered, as he is accustomed to such; 10 years in present position. Box 876, AMERICAN MACHINIST.

Help Wanted.

Wanted—A first-class patternmaker at the Reeves Engine Company, Trenton, N. J.

Die-sinkers wanted, accustomed to drop-forged work. The Kilborn & Bishop Co., New Haven, Conn.

Wanted—First-class toolmaker foreman; none but first-class men need apply. H. Scherer & Co., Detroit, Mich.

Wanted—Three men familiar with Gleason bevel planer, in Pittsburg district. Address Box 6, AMERICAN MACHINIST.

Mechanical and structural draftsmen; experienced technical graduates preferred. Box 71, Station B, Cleveland, Ohio.

Wanted—First-class, all-round machinists; steady work and good wages to good men. Reeves Engine Co., Trenton, N. J.

Draftsman wanted in mechanical department of large rubber factory; work not difficult. Address Box 16, AMERICAN MACHINIST.

Machinists, send for free blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—First-class patternmakers, molders and machinists; good wages and steady employment. Address Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—Mechanical draftsman, patternmaker and toolmaker; new shop; 60 hours per week; state experience, age and wages. Columbus Iron Works Co., Columbus, Ga.

Wanted—Three patternmakers, accustomed to engine work; six machinists; best wages and steady work guaranteed; references required. Apply Box 875, AMER. MACHINIST.

Wanted—Patternmaker on wood patterns for machinery, competent to act as head patternmaker and foreman; permanent position to right party. Box 888, AMER. MACHINIST.

Wanted—An experienced salesman to sell high-grade tool steel and other steel in New England States; state previous experience and salary wanted. Box 28, AMER. MACH.

Mechanical draftsman, man familiar with automatic machinery, for about two months' work; state experience and give references and salary. B. W., care AMER. MACHINIST.

Wanted—Superintendent for concern manufacturing electric hoisting machinery; thorough knowledge of business necessary; state experience and salary. Box 863, AM. MACH.

Wanted—Good armature winders and brass finishers; steady employment and good wages to first-class hands. Apply to Canadian General Electric Co., 8 Queen st., Montreal, Que.

Mechanical draftsman and designer with experience in machine tool work, also practical shop experience; state age, experience and salary desired. Bignall & Keeler Mfg. Co., Edwardsville, Ill.

Wanted—A foreman for machine shop in New England employing 100 men and building medium weight machinery by up-to-date methods. Address, stating age, experience, salary required, etc., Box 12, AMER. MACH.

Wanted—Three first-class toolmakers on small jigs and fixtures for interchangeable work; factory in St. Louis, fine surroundings; highest wages paid to good men; transportation paid. Address Box 7, AM. MACH.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Blacksmith—A first-class machine blacksmith as foreman in an up-to-date, well-equipped forge; must be an A1 man and thoroughly understand his business. Address, stating experience and references, "Blacksmith," care AMERICAN MACHINIST.

Swedish-American Foremen.—Wanted—Several first-class Swedish-speaking machine shop foremen, well up to date in modern shop practice; apply in Swedish, stating age, experience and wages expected. Address Aktiebolaget Separator, Stockholm, Sweden.

Help Wanted.—Machine shop foreman in manufactory of engines and threshing machinery; must be experienced, acquainted with modern methods and of good executive ability; in answering give references, experience and salary expected. Box 3, AM. M.

Wanted—Experienced mechanical draftsman for position with a large manufacturing company located in Pennsylvania; applicants should state experience, age, salary expected and furnish reference; good position for the right man. Box 859, AMERICAN MACHINIST.

Wanted—Mechanical draftsman, experienced on stoker, boiler, boiler settings and general engineering work; resident Chicago preferred; state age, references and salary expected. The Under Feed Stoker Co. of America, 837-42 Marquette Building, Chicago.

Wanted—Experienced machine shop foreman by shop employing about 50 machinists; mill and water wheel work; must be first-class mechanic and capable of handling men to best advantage; permanent position; state age, experience and references. Box 26, A. M.

Wanted—A foundry foreman; must be used to a great variety of work in green, dry sand and loam; must be intelligent and steady, able to mix metals and handle men; the right man would find this a steady and attractive opening; references required. Apply Box 874, AMERICAN MACHINIST.

Wanted—Two or three good boilermakers and sheet iron workers, to make tanks, smokestacks, blast pipes, coal chutes and general work in this line; steady work and good wages in a first-class, modern shop in Western Pennsylvania, will be given to the right man. Address, stating age and experience, Box 877, AMERICAN MACHINIST.

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Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Troy File Works, Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Pattern Works, Chicago, Ill.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
French Mfg. Co., Kansas City, Kan.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathe Feed
National Mach. Tool Co., Cin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Brown & Sharpe Mfg. Co., Providence, R. I.
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Straley, Hasbrouck & Schloeder, New York.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Prentiss Tool & Supply Co., New York.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Engr. Works, Chas F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Works, Chas F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Elmes Engr. Works, Chas F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Hermann Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Hermann Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincinnati, O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
National Mchry. Co., Tiffin, O.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Molding Pipes Without Patterns.

BY FRANCIS W. SHAW.

Every jobbing iron founder and molder is probably familiar with the method of making pipes by striking up a loam core upon a prepared templet, drying and adding a thickness, which is peeled off after using the thickened up core as a pattern. As a rule, this method necessitates the lapse of a cast to permit of making cast-iron core templets, and in any case some little time must be lost during the preparation of the loam pattern.

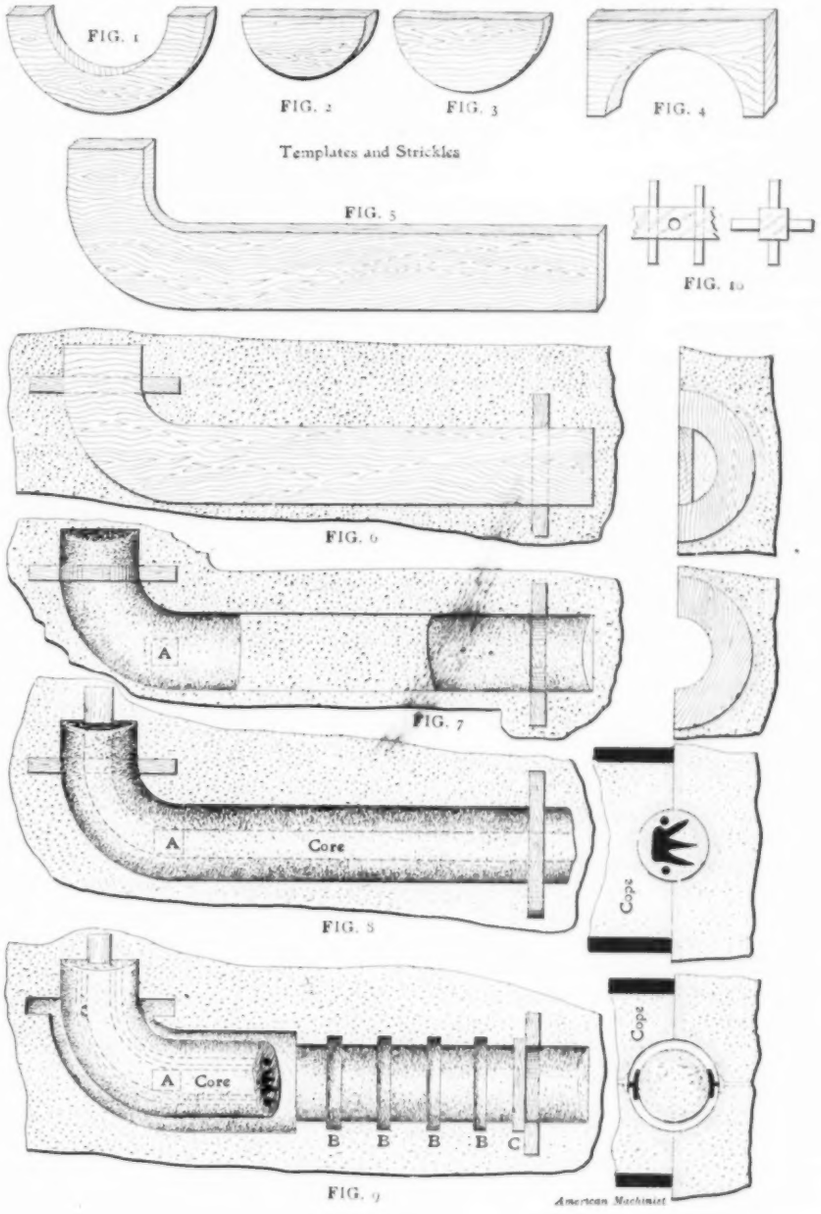
The method I am about to describe, however, enables molding operations to be commenced immediately, allowing of course for the time spent in making templets, strickles, etc., which would have to be made even for the method just mentioned.

For the purpose of explaining in detail the method, I take, for example, a double-flanged bend or elbow. For this pipe, the patternmaker would make four half-flanges, Fig. 1, cut to fit the core, two templets (true semi-circles); one (Fig. 2) the diameter of the core, the other (Fig. 3) the diameter of the pipe. If for a 3-inch pipe the former would be 3 inches diameter, the latter, say, 3¼ inches; one strickle (Fig. 4) cut to the size of the core 3 inches in the supposititious case, and one templet (Fig. 5) exactly the same shape and size as the lengthwise section of the core, *i. e.*, 3 inches wide for a 3-inch pipe, this templet to be about 3 inches longer at each end than the required pipe.

Figs. 6 to 9 show how to proceed with the molding of the pipe. Prepare a level bed rather larger than the box part to be used, and bed in the core templet, with two half-flanges in position, level with the surface of the bed (see Fig. 6). Now remove the templet and strickle the sand until the straight side of the strickle is level with the bed. Fig. 7 shows this operation partly accomplished. Before finishing off this part of the mold it would be well to insert, some distance below the surface—a distance regulated by the length of stock chaplets—a block of wood to form a support for the chaplet. By the neglect of this simple matter, or by placing reliance upon the chaplet simply having its support by the pressure of the sand upon it, much trouble might, and often does, ensue. This block of wood can afterward be located by pressing in a vent wire and feeling for it. Fill up the groove strickled out with first a layer of wet parting sand, then facing sand and then floor sand, and bed in it a core iron and ropes to form the vents, which ropes are to be withdrawn after completing the core. I have shown two vents, one of which, however, is provided only as a safeguard in the event of one becoming blocked up. In order that there may be no liability to disrupt the core in drawing the ropes, it is better to insert two short ropes for each vent, overlapping where they meet at the bend of the core.

Complete the core, as shown in Fig. 8, piling up the sand and striking it to shape by means of the strickle, Fig. 4, care being taken the while that the top half matches the bottom one. Smooth the core and cover with a thick coat of wet parting sand. Withdraw the venting ropes and plug up the vent holes to prevent them becoming filled with sand while ramming up the cope. Fix on the other half-flanges and sprig them in position. Fix on the cope and ram up as usual. Remove the cope and then the core. Now loosen the sand at intervals along the mold and stamp in the templet, Fig. 3, care being taken that it is stamped in concentric with the mold in which the core was made. At *C* is shown the templet not removed, and *B B* are the grooves formed by this templet. Cut away the sand between the grooves, using the templet to insure a correctly joined mold, and similarly in case of the cope. The left-hand half of the sketch shows the core fixed in position on the finished mold resting upon a chaplet *A*, and the end view is a section of the finished mold with the core in position and covered. The mold will be vented, and runners and gates and risers made in the usual manner.

If now a casting is required in a hurry, to enable it to be made the same day, instead of the cast core iron shown, there must be prepared a wrought-iron one, made from, say, 1-inch square bar iron, the bar bent to shape, drilled at intervals and ⅜-inch round and short bars inserted, as shown in Fig. 10. To get this bar out of the finished casting, a little trouble will be entailed in straightening it by sledge-hammer blows, aided in some cases by a short, stumpy bar, to rest upon the inside end of the core iron when it is drawn out



MOLDING PIPE WITHOUT PATTERNS.

of the pipe as far as possible. By degrees, it will be possible to straighten it sufficiently to enable it to be withdrawn.

Although I have shown a flanged bend or elbow, the method is available for pipes of every description, straights, bends, V's, Y's, T's, either flanged or socketed; but in the case of socketed pipes, although not absolutely necessary, it is advisable to have a socket pattern in halves made. The appearance of the pipe of course depends upon the dexterity or want of it, as the case may be, of the molder. The core being made in green sand will not be so firm as a dried loam core, and care must be taken to get it by the well—but not too well—using of the trowel.

The Difference Between Good and Bad Pattern Work.

A prevalent idea among the uninitiated seems to be that any first-class joiner will make a good patternmaker, but such is not necessarily the case, as he may lack all of the most important requisites.

A competent patternmaker should, above all, thoroughly understand the processes of molding, as well as the little "knacks" of making a good, clean mold, brought about generally by a well-designed pattern; for I consider the art of pattern *designing* to be as necessary to the patternmaker as that of machine designing is to the draftsman.

Someone may suggest that if a pattern is made like the drawing all requirements are fulfilled. This is not so, however, as the drawing usually shows the piece complete after machining, and, except in rare cases, never shows the patternmaker how to build up his pattern, how and where to make the most serviceable joints, how much stock should be left for finish, which way the grain should run, how much draft to allow, etc.

Before the patternmaker begins on a job he should study his drawing carefully until he thoroughly understands every part of it. It then devolves upon him to decide how it can best be molded, and upon his decision rests the responsibility for the shop profit. If he makes a poor decision the cost of molding may greatly exceed the estimated cost, or, after one or two unsuccessful trials, the pattern may be sent back to the pattern shop to be rebuilt; or, if they are successful in getting a casting, it may be rough and distorted to such an extent as to cause extra cost in machining.

Suppose he has decided how it can best be molded, he must then decide how to build it up to give the most rigidity, and, in case it is to be a stock article, the longest life. Ample provision must be made for spring in molding; the grain must run in such a way that the pattern will not split or warp out of shape, remembering that wet sand will warp anything not amply provided for. He must look out that all joints are made in such places and in such a manner as not to be easily split apart, using both nails and glue. A joint which opens up a little immediately fills with sand, so that it can never be closed again, and forever after causes unnecessary work in the machine shop. To be sure, this unnecessary work is at first minute, but the opening of the joint occurs often, and is constantly increasing, so that it will in time eat into the profits.

Now he must turn his mind to the amount of stock required for finish, the strain of the hot iron in the sand and the shrinking of the casting. The stock for finish can be determined only by much experience and still more common sense. I have known patternmakers to leave as much stock for finish on the hub of a small lever, where only one hub was to be finished, as on a big frame having dozens of places to be finished, some of them far apart, and where great care had to be used in molding to avoid the springing of the pattern. On the small lever there should be just stock enough to get under the scale and no more. On the big frame it would be necessary to leave some more than this, depending on the liability of the pattern to spring or warp.

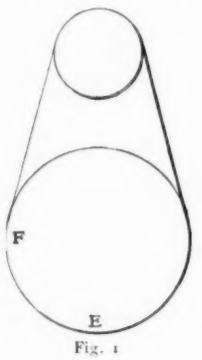


Fig. 1.

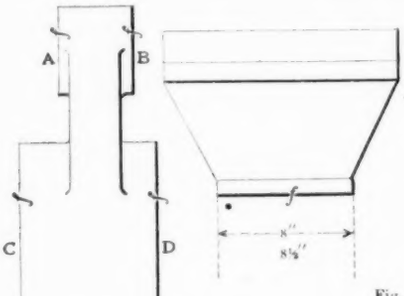


Fig. 2.

INACCURATE WORK OF PATTERNMAKERS.

In determining the amount of strain and shrink, we must have an intimate acquaintance with the particular foundry doing the work, always remembering that a small pattern will be "rapped" in the sand more than enough (at least in two directions) to make up for the shrink, and consequently should generally be made rather smaller than the drawing, while a large casting will sometimes strain in the sand enough to cause trouble if it is not provided for in the pattern.

The draft required is rarely shown on the drawing, except in those places where too much or too little would cause trouble. Some draft is always necessary, the amount depending entirely upon the job, care being required never to allow too much. For instance, a hub having a large amount of draft looks bad, and, on the other hand, if too little or no draft is allowed the mold will be broken in drawing, producing castings hard to clean and which will always be more or less rough. More draft should always be allowed on the cope side than on the nowel side.

Next comes the matter of round corners and fillets; sometimes these are shown on the drawing and sometimes they cannot be shown. Wherever they are shown the pattern should of course be made just like the drawing, but where they are not shown the patternmaker will have to use his judgment, or, better still, ask the chief draftsman's advice, as he generally knows where a pattern can be rounded and where not. Always make good, smooth, round corners wherever possible, even on finished surfaces, taking care not to round off quite to the finish line. The same can be said of fillets; they should be put in wherever possible, and the larger the better, within reasonable limits. Do not under any consideration leave out the fillets simply because they are down in a recess where they can't be gotten at easily; there is all the more reason for putting them in.

All except the smallest patterns must be provided with sufficient draw plates, and it is not enough to simply fasten them on the outside; they must be let into the wood, and in such places that they will be used—*i. e.*, where the pattern will balance best when drawing, remembering that some parts will be retarded by the sand more than others.

Fill up all holes and cracks with putty; this is better than wax. Give the pattern a coat of thin shellac and when dry rub down well, being careful to see that there are no bunches or rough places to catch in the sand, then put on a finishing coat of shellac, and the pattern is complete.

One of the most important qualifications of a good patternmaker is to be able to measure accurately. Very few so called "carpenter patternmakers" can do this, for the reason that all previous experience has been on work where it was not required. Take, for instance, cabinet work. A desk or a table will have good close joints all around, but it may be 1-16 or ⅛ inch too wide or too high; this makes no difference in the case of the desk or table, but consider the difference that it would make on a pattern where it would make just so much extra stock to be planed off here, or a hub there might be shy, making it necessary to rivet on a piece, or a boss supposed to be ⅛ inch above the main part of the pattern might all plane off

down to or below the main part, causing unnecessary annoyance to everyone, and often costing many dollars in the shop, besides much of the chief draftsman's valuable time. For this reason it is necessary that all patterns should be carefully measured before being sent to the foundry.

Having tried to enumerate a few of the qualifications of a good patternmaker, I will now try to illustrate some of the failures of a poor one as occurring in my actual experience.

It devolves upon me as chief draftsman to measure all patterns after they are finished. One of our patternmakers was originally a cabinetmaker. He can make a fine-looking pattern, but it seldom measures very close, and the finished pattern, after it has been carved out here and patched up there, under my instructions, is at best only an approximation, which anyone can readily see will always give trouble.

To illustrate: In the pattern shown in Fig. 1, he was told to put on 1-32 inch stock where marked *f*. At *A* and *B* he had 1-32 inch stock, at *C* he had 1-16 inch and at *D* he had no stock whatever. On measuring the hubs for draft it was found that the outer ends calipered about 1-32 inch smaller than at the center; this appeared all right, but when I came to put a straight-edge across it I found that it was at least 1-32 inch low in the center on two of the sides *E* and *F*, the other two sides being rounding enough to give the apparent draft as calipered. His explanation was that the shellac on the ends of the hubs had swelled them.

In Fig. 2 (the sketch is not to scale) the figures on the dimension lines are the same as the drawing, while those directly under them show how the pattern actually measured at those places.

These two cases are not extremes, but are exactly similar to those I am finding every day. Of course there are cases where a pattern will be very close, but these are few, and there are many cases where the finish dimensions will be first rate while some other part will be more or less out. When I find such a case and I know that it will do no harm, I let it go, marking the error on the drawing.

X.

Careless Designing.

BY PETER H. BULLOCK.

I am not a designer nor legally honored by any mechanical degree—just simply a mechanic who has been in charge of erecting, operating and maintaining steam engines and mechanical apparatus for a good while and who now finds much of his time devoted to saying how a good many things shall be done. In such a position one runs against lots of things which others have designed, and it is mighty easy to see how the form and style of some of them might have been improved, and often without any sacrifice of strength or increase of cost. I admire a well-designed thing, be it a tandem engine or a boot-jack, and equally I detest anything that lacks all the features of beauty, utility or convenience that might just as well have been introduced.

To illustrate: We have an engine that has a hexagon nut on a valve stem stuffing-box, and the housing is so curved down that the nut cannot be turned one-sixth of a turn by any single movement of a wrench. The wrench has to be made with an offset handle and then turned over each time to make the 60 degrees of movement. The stock might have been so disposed as to give 90 degrees and then have been equally as strong.

There is a side crank engine which has two generators on its shaft, and of course there is a center bearing between them. The cap of this bearing sets about as shown in Fig. 1, so that the edge of the bearing is a half inch higher than the bottom, and yet that half inch made a

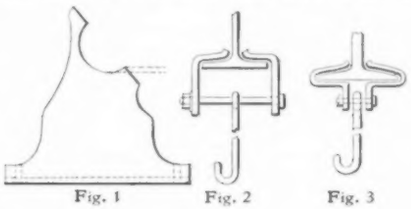


Fig. 1 Fig. 2 Fig. 3

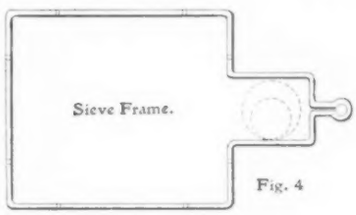


Fig. 4

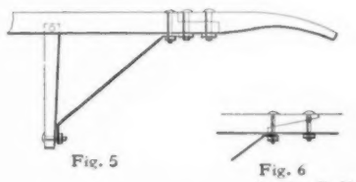


Fig. 5

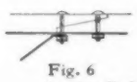


Fig. 6

American Machinist

SOME MISTAKES IN DESIGNING.

day's work hoisting the field frames and crank-shaft that much to get the bearing out when it had to be done. Yes, certainly, I planed off a half inch at the dotted lines and put in steel for shims—but why in the name of common sense didn't the other fellow do this in the first place?

I exercise a sort of suggestive or mild veto power over the mental creations or designs of some others who wish to have something constructed. Now, if a man brings in a well-made sketch, even if it is obviously wrong in either form, material or both, he does not like to have it turned down and there is a good chance for the exercise of tact if one happens to have a little on hand. I will illustrate by a few recent cases:

A pipe was to be supported under some I-beams and a sketch like Fig. 2 was submitted. When Fig. 3 was suggested as being better, he said he had thought of that, but thinking his style easier to make (!?) he had made the sketch that way, but "never mind, make it your way." A cheerful prevaricator adds to the joy of life.

A sketch like Fig. 4 was submitted to me a few years ago, and there was no financial or mechanical objection to *making* the forging as desired, but, as he told me what he intended to use it for, I felt constrained to say "don't." He operated a mill where, among other things, there was a machine for crushing a mineral substance. On the vertical shaft of the crusher there was a cam of ¾-inch throw intended for another purpose, but which the owner was going to use for shaking a sieve to go in the frame he wanted made. As the speed of the cam shaft was 600 per minute, it was evident to me that there would surely be a financial loss and a mechanical failure in any attempt to operate the thing. It would have been a pretty lively place in that 4x5-inch opening, and the ¾-inch pin in the end would have had to work overtime to have kept its job while the other end of the rig was swinging 5 or 6 inches ten times every second.

Yes, almost every man is a designer. Only yesterday I saw a wheelbarrow handle that had just had some repairs designed and executed upon it. It was done like Fig. 5—notice the ½-inch bolts. How easy it would have been to have done the job like Fig. 6. There evidently is no one exercising a suggestive or veto power in the wheelbarrow department of that contractor.

In the foregoing I have tried to make clear some ideas about designing and have introduced the various cases the same as a lawyer introduces former decisions to prove or strengthen his position. But seriously I wish to suggest to you gentlemen who do really design things that you have to design them but once and the builder has to construct a machine but once; but somebody, the owner or his hired man, has to live with and operate it a good while. Now, when patting yourselves on the back for some mechanical masterpiece, just stop awhile and imagine yourself the fellow that has to set it up or take care of it and then go over the plans again and do a little something for his benefit.

The First American Foundry.

At the Old Home Week exercises held this summer at Carver, Mass., an interesting paper relating to the early history of the town was read, in which it was shown that, as far as now known, the first actual casting of iron in America was done there, the article produced being a teakettle. The first furnace was in operation in 1735, and a second one was built in 1760, the latter date being that of the historic teakettle. The successor of this second furnace is still in operation, under the firm name of the Ellis Foundry Company. Carver seems to have been the first home of a now prominent foundry. The Federal

Furnace was established in 1793 and survived until 1841, when it was burned, the proprietors being Bowers & Pratt, who then moved to Boston and established the Highland Foundry in Roxbury. Another Pratt established a furnace at Wenham, Mass., the same year, and his son later opened the Watertown foundry, now so well known as that of Walker & Pratt. The paper above referred to had to do with genealogies rather than with foundry history, so that its account is not as full and clear as from our view point could be wished.

Evolution of the Spring Caliper.

BY E. R. MARKHAM.

At page 909 of the AMERICAN MACHINIST, in the article "From a Designer's Note Book," is a cut showing a form of "rapid transit" nut, which calls to my mind a number of incidents and changes that have taken place in the *evolution* of the spring caliper, which I thought might be of interest to your readers.

The J. Stevens Company—afterwards the J. Stevens Arms & Tool Company—of Chicopee Falls, Mass., manufactured for years a spring caliper patterned after the English tools which were sold in this country as the "Stubbs" calipers.

I can remember as a boy six years of age going into their blacksmith shop and watching Grandpa Spalding—as he was known to the village boys*—forging calipers and dividers. The legs and bow were made, as will be seen by a glance at Fig. 1, in one piece. There was at this time no drop or power hammer in the shop; all drawing of stock was done with hammer and sledge, and the shapes were produced with special hand tools and forms rigged up as jumpers. The calipers after forging were sent to the machine shop to have the necessary machine work done on them, after which they were returned to the blacksmith shop to be hardened and tempered. Little did I think as a lad of six years that twenty-one years after I should have charge of making this very caliper in this shop—but I am getting ahead of my story.

After manufacturing this caliper for many years, the company put on the market what was known as their patent helical coil spring caliper, a cut of which is given in Fig. 2. This was made from steel wire; th spring was coiled and the legs flattened and bent to shape. It was necessary to cut a slot nearly the entire length of the screw, leaving it solid at each end; the slot was necessary, as the screw had to straddle the legs. This tool never met the expectations of the company as a revolutionizer of the caliper business.

About the year 1878, Charles P. Fay, working as an apprentice for the abovementioned concern, invented and had patented a caliper of the form shown in Fig. 3. He afterward sold the patent right to a Mr. Hyde, of Springfield, Mass.; it was known as the Hyde patent screw caliper. The operation of the caliper will be seen by a glance at the cut. Two coil springs which were inserted in the cross-bar *a* kept the legs against the screws shown at each end of the bar, but as there was no provision for taking up wear in the joints, or back lash in the screw, the popularity of this tool was short lived.

Shortly after this, Mr. Fay invented and had patented a detachable bow caliper, which differed from the Pond caliper made in Worcester, in that the bow was placed above the joint of the caliper and opened it by compressing the upper end of the legs, as shown in Fig. 4. As the pressure of the bow kept the legs together, all that was necessary for a fulcrum was a pin fitting in a semi-circular shaped slot in each leg. A cut of the fulcrum pin—or joint stud—is shown in Fig. 5, which also shows a view of the legs and slot to receive the pin.

Mr. Fay started the manufacture of this caliper in Springfield, Mass., in 1885. I went to work for him in the fall of the same year; shortly afterward I was appointed foreman of his shop. During the summer of 1886 he placed on the market a cheaper form of his caliper and divider, known as the "Yankee"; his object in making this caliper was to meet the cheaper forms of goods sent to this country from Germany.

The quick-adjusting nut put on the Fay caliper and divider and on the Yankee, when ordered, is shown in Fig. 6. This nut, after being made to shape and drilled and tapped in the screw machine, was placed in a jig and hollow milled on two opposite sides to receive a ring. After elongating the hole in the small end of the nut, it was sawed in two and filed, to allow the small end to close in order to open the opposite end that contained the thread, and to release it from the screw. A ring was soldered in opposite sides of each part of the nut, which was then put together and polished.

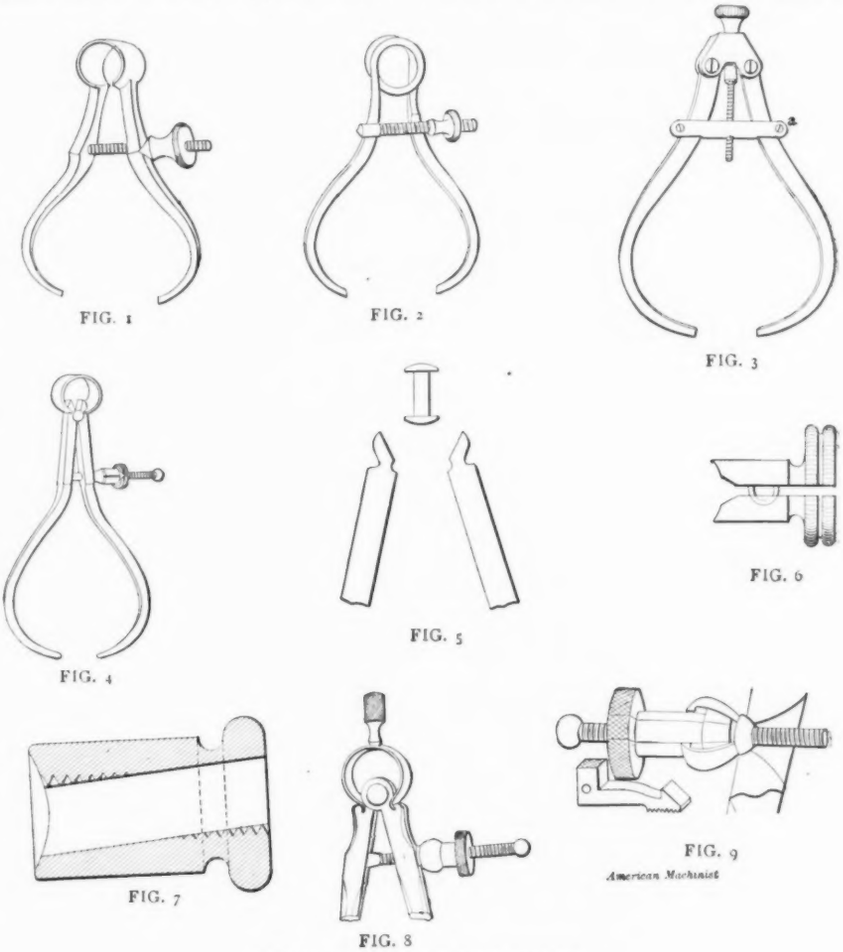


FIG. 1 FIG. 2 FIG. 3

FIG. 4 FIG. 5 FIG. 6

FIG. 7 FIG. 8 FIG. 9

American Machinist

EVOLUTION OF THE SPRING CALIPER.

At some time previous to the putting of the Fay quick-adjusting nut on the market the nut mentioned under the heading "From a Designer's Note Book" was brought to our notice; this form of nut is shown in Fig. 7. At about this time—I cannot recall the precise date—another form of quick-adjusting nut, known as the Richardson rapid nut, was added to the list, and was used by the Stevens Company in connection with their calipers, when ordered.

In 1887 I accepted a position with the J. Stevens Arms & Tool Company—formerly the Stevens Company—in charge of their fine tool department. They had pre-

* Father of our contributor B. F. Spalding.—Ed.

viously brought out a detachable bow caliper, whose legs were joined together by means of a half-and-half joint, the bow being connected with the legs below the joint and operated similar to the Pond caliper bow. Fig. 8 shows the joint and bow. Shortly after I became acquainted with them the joint was changed and a compression bow substituted for the style formerly used, on account of the possibility of getting a much evener tension. The form of quick-adjusting nut used by them is shown in Fig. 9.

They afterwards put on the market a cheaper form of caliper, known as the Leader. They continued to manufacture the solid forged caliper up to the time I left their employ in 1895, but on a very small scale, as the detachable bow goods gave much better satisfaction, and the tension of the bow was much evener, especially on the large sizes.

In 1887 L. S. Starrett, of Athol, Mass., bought out the Fay and Yankee caliper and divider, and with some slight improvements is manufacturing them now.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., have recently gone into the manufacture of detachable bow calipers and dividers.

While there have been some changes in forms of joints and styles of quick-adjusting nuts, the detachable bow caliper made by the three leading manufacturers of these goods is substantially the same as Mr. Fay brought out nearly twenty years ago.

When Mr. Fay sold out his business to Mr. Starrett he went to Athol to oversee the manufacture of the goods. Nine years later he left Mr. Starrett's employ, and returned to the J. Stevens Arms & Tool Company. He is now works manager and part owner of the concern.

It is very interesting to note the growth of that company, that a few years ago employed about thirty hands, to-day employs, I am informed, about 1,400 hands. Fifteen years ago their product was carried to the express and freight offices every night on a wheelbarrow. I think it safe to say they find it necessary to use some different method of conveying their goods to the railway at the present time.

Notes by a Wandering Mechanic.

MILLING BRASS CAPS—MILLING THREADS IN A GUN BREECH—TOOLROOM CASES FOR MILLING CUTTERS, SAWS, ETC.—SCRAPING LATHE BEDS—BORING FIXTURE FOR HEADSTOCKS AND FOOTSTOCKS—MILLING MACHINE BORING FIXTURE—A RACK CUTTER.

BY H. GOLDSMITH.

Not being able to stand those Jersey mosquitoes any longer, I decided to be off up into the Eastern States. Bridgeport, Conn., was the next camping place on my program, and I arrived there the forepart of November. After inquiring at a few shops and being refused work, I decided to try one more, and if not successful to take the next train for Hartford. Luckily I got a position in the shops of the American Ordnance Company, in the breech mechanism department, and was told to come to work the next morning. Then came again that ugly job of looking for a

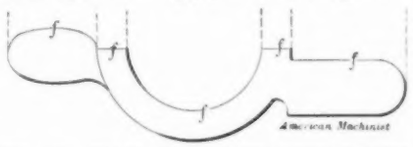


FIG. 30. BRASS CAP MILLED WITH FORMED CUTTERS.

boarding house, and after inspecting a half-dozen and being informed at each place that they had nothing but the best on the table, chicken three times a week, pie four times a week, Mr. So-and-so boarded with them for not less than ten years and Mr. So-and-so did this and that, I at last, in sheer desperation, decided on a place, and had no cause to regret it later.

Bright and early the next morning I reported for work, receiving a key to a drawer containing a hammer, chisels, files and an oil-stone. I was given also a long pole provided with two hooks—one being attached to the end and the other one lower down—to hang such clothes on as I wished to discard during working hours. After hanging your clothes on the lower hook the pole is raised and attached by the upper hook to a steam pipe near the ceiling. This arrangement for taking care of the men's clothing is very cheap and seemed to be in favor with the men. On my rubbering tours during noon hours I saw a number of ideas which struck me as being worthy of mention.

On the field guns made there a number of brass caps—like Fig. 30—about 2 inches long, are required. These were completed in one operation on the milling machine with gang cutters, a very nice and well-finished job being made. Large surface plates, 7x5 feet, are mounted permanently on trucks and are rolled to different parts of the shops when wanted; this makes a very substantial and satisfactory way of keeping them in condition. Fig. 31 shows a counterbore with an adjustable stop-collar—a very handy tool. The difficult operation of cutting the very coarse pitch screw threads in the breech of the guns was accomplished very rapidly and accurately by a formed milling cutter—made to correspond to the pitch of the thread—mounted on a spindle in a special attachment fastened to the carriage and bed of the lathe. This device is shown in Fig. 32. The driving cone is belted from the countershaft, and the lead screw geared up to the correct pitch for feeding the cutter. The cutter is then run into the breech and makes a very clean thread. It seems to me that this device could be used to advantage by lathe manufacturers for cutting the thread on the nose of lathe spindles.

In Fig. 33 is shown one of the three tool cases in their toolroom. These cases are arranged in a very convenient manner.

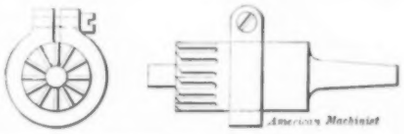


FIG. 31. COUNTERBORE WITH STOP COLLAR.

The top shelves are for such tools as reamers, mandrels and drills. The drawers are partitioned off and contain surface mills, saws, formed cutters, etc., each drawer containing a different class of cutter. The drawers for end mills are so arranged that each mill has a place to itself. The surface mills are grouped by sizes, each size having a separate compartment. Counterbores are arranged in the same manner. When a person asks for a surface mill the entire drawer is brought out and he selects the mill best suited to his work and leaves a check for it.

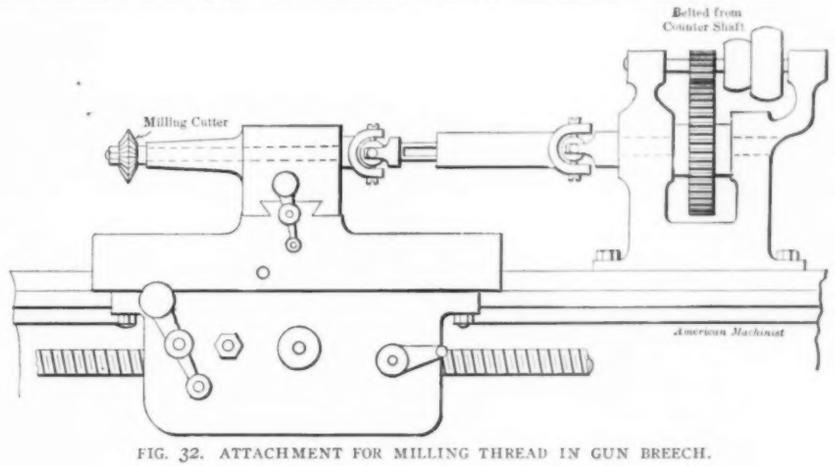


FIG. 32. ATTACHMENT FOR MILLING THREAD IN GUN BREECH.

All attachments belonging to the milling machines, such as chucks, vises, dividing heads, etc., are kept in the toolroom, and a full line of lathe, planer and shaper tools is also kept there, everything being issued on check.

After a three weeks' sojourn there I handed in my checks and wandered up the State into the shops of the Hendey Ma-

chine Company, and I want to say here that the reputation that these people have is well deserved. The shops are of the latest construction and well lighted. The work is made to standard gages and everything is systematized. All lathe parts, such as patent gear boxes, headstocks, tailstocks, carriages, etc., are built in lots of twenty-four. They have a great many interesting special tools and fixtures; one of these fixtures is shown in Fig. 34. This is an ingenious device for boring headstocks and tailstocks. Each size of headstock has a separate fixture (which also answers for the tailstock), which is bolted securely to a base. In boring out the headstock, both the spindle and back gear bearing are done in one operation. Another fixture, which must have cost considerable, bores out simultaneously the bearings for the spindle, back gear shaft and overhanging arm in their milling machines. Nearly all milling machine manufacturers bolt a fixture against the column of the machine, with provisions in this fixture for carrying the bars and for driving and feeding them, but the Hendey Machine Company reverse this practice, and bolt the column of the miller, which has been scraped to a templet, to the bed of the machine or fixture. This has been accurately planed, and is provided with three boring bars, with feeding and driving mechanism, the bearings for the bars being located to correspond to the holes to be bored. After the work is once set correctly it is absolutely impossible for any of the bearings to be out of alinement with each other or with the column of the miller. To sketch this boring machine out properly would be a difficult task, but I think the above description will give an idea of the arrangement.

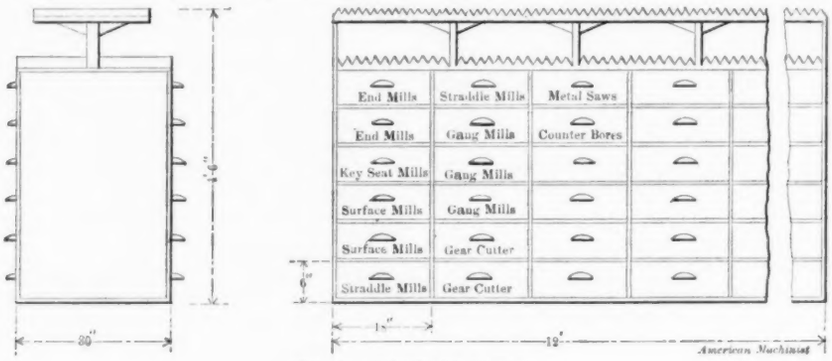


FIG. 33. TOOLROOM CASES.

Another clever device in this shop is a rack cutter which has been manufactured out of one of the Hendey shapers. An extra head is attached to the machine and arranged to carry a suitably formed milling cutter and gearing for driving it. The rest of the machine is arranged the same as an automatic gear cutter, mechanism being provided for automatic feeding, return and spacing.

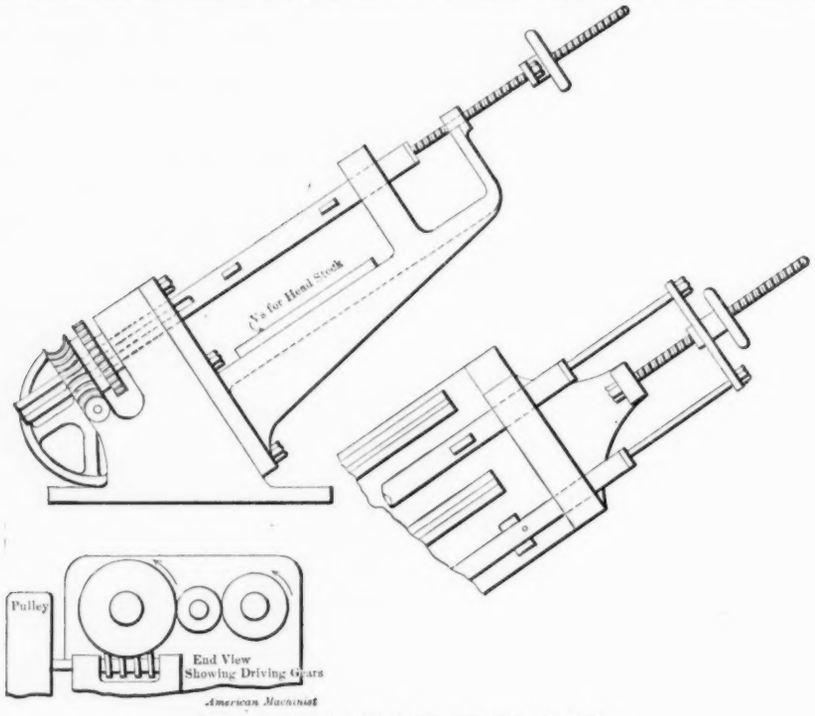


FIG. 34. BORING FIXTURE FOR HEADSTOCKS.

A very novel method is employed for scraping their lathe beds. The carriage and bed are scraped to a bearing with a false headstock clamped to the bed in its proper position. For they have discovered that no matter how well the head is scraped, the clamping of the same to the bed will spring it. In fact the writer had the same experience at one time while an inspector—lathes as large as 30 inches swing being sprung by the headstock clamping bolts.

They have in the engine-room at the Hendey shops a safety stop which is connected with push-buttons located at various points about the place. When a button is pushed a bell in the engine-room rings and the engine stops immediately. This is an excellent arrangement for preventing serious accidents.

Echoes from the Oil Country.

TALLOW AS AN ENGINE AND PUMP LUBRICANT.

In going around among the various pumps and steam engines that fell to my lot in the earlier days, one of the first things that made an impression on me—I might almost call it an indelible impression in some cases, so hard did it stick to my clothes—was the varying amount of dirt that I accumulated while making examinations of the steam cylinders. Some were hard and shiny, while others were soft and smeary, looking as though lubricated with a mixture of printers' ink and coal tar. Those that came in to be rebored were oftener of the latter kind.

In those days—and I regret to say that the days are not entirely past in some places and with some people—a tallow cup was the usual lubricator. Sometimes a little oil, of any convenient kind at hand, was also put into the tallow cup, and occasionally some more advanced engine runner would try to do without the tallow; lots of them did without either oil or tallow. In either case the results were, sooner or later, in favor of the job shop man. Indeed his own practice was not always in advance of his neighbor's.

In one little place the shop was run by a small upright engine. This engine was entirely innocent of any intention of acting as an example of advanced practice, and was without any means of getting a lubricant of any kind into the cylinder. Being upright, this did not matter much, until one day the rings went to pieces after having worn so as to be not very good.

Here was an emergency. Lots of work, customers waiting, money scarce. Time in this case was the essence of things, indeed. It did not take long to get that piston head out and a solid ring of babbitt metal run into the ring space and, with the largest man in the place as motive power directly attached to the lathe belt, to turn it down so that it would just crowd into the cylinder. This left the head quite loose in the center and not as

good as a good set of snap rings would have made it, but as the old head took the old three-ring packing, snap rings meant a new head as well as rings. That would be a job for after supper some evening, and would have to wait, as what was now wanted was motion much more than the greatest economy.

The speed of this engine was governed by the boy who acted as engineer and fireman, and incidentally ran a lathe and looked after the machinery generally. One of the things he rather prided himself on was the ability to keep the engine going to suit the most important job under way at the time, and he would often go and give the throttle a slight turn one way or the other to have the speed just right, when no one else had noticed any variation.

This running with a head made largely of babbitt was a new thing to him, and he watched with interest. Everything started off nicely, and he had concluded that babbitt was pretty nice stuff to have around for engine repairs, when the engine began to slow up, and he sprang for the throttle and shut off steam, looking around to see if someone was getting pulled into a machine somewhere, or whether someone had over-estimated the amount of cut that engine would pull. Everything around the shop appeared as usual, and steam was turned on again. In a few minutes the engine slowed again and was again shut down, and a walk was taken around the shop, but everything was in proper shape. Again the engine was started and the boy went down to fire up the boiler. On his way back things began to slow down again, and before he could reach the throttle the engine stopped, giving several groans as it made the last turns.

That head had expanded enough to stick good and hard. After standing still a few minutes it was no trouble to start again, but a very few minutes' running was enough to show signs of trouble.

A ratchet drill was rigged up and a hole was drilled in the top of the cylinder. The steam was left turned on enough to blow the chips out as the drill cut through. As this engine had the cylinder below and the wheels above, you can readily see why the cylinder head was not removed to drill this hole. When the hole was drilled it was tapped with a pipe tap and a lubricator was screwed in. This lubricator was one of those common fellows that was very generous when full, being the same kind that was used for tallow. A small globe valve on the side could be closed and the cup filled while steam was on the cylinder.

When this lubricator was in place and a liberal allowance of oil was run into the cylinder, things ran very well for a time, but if the boy did not guess right in opening the valve for feed, or if the steam had to be run up and the engine speeded up, there was trouble. Only by constant attention was that engine kept going until a new head with snap rings could be made. It took very quick work to get the lubricator cover off and some oil in in time to keep the engine from stopping after it had begun to slow down, but shutting the steam nearly off would help to do the trick. A lump of tallow served its purpose in this place, as it seemed to last longer on the babbitt than oil did.

One of the things observed when tallow was used as a cylinder lubricant was the way it would work into a piston head and form balls in connection with the rust. The first ones I recollect seeing were when I was repairing a sawmill engine, and I called the engineer's attention to them as an evidence that someone had been very careless in putting that head together. It was the old style head with spider, follower and three-ring packing. I was rather skeptical when he told me those balls (they looked like marbles) grew in the head. Breaking them with a hammer showed they were some sort of a peculiar formation entirely different from any marbles I had ever played with.

I have often found them since, and sometimes they do considerable damage to the heads. Indeed, I have seen heads worn so badly as to be worthless, and in one case I recollect where a hole was worn through the end of a head by them. That they were caused by the action of tallow on iron I believe, as I never found any in heads where tallow was not used, although they were not found in all heads where it was. A loose jointed, poorly put up head did not seem so apt to have them as one that was well made, and I have found them in old solid heads. By solid heads I mean those cast in one piece. They had a core space inside which was closed by three pipe plugs which were screwed in solid after the core sand was cleaned out and the head put on the rod. All the chance for anything to get into such heads would be by leaking through by the plugs.

While tallow made us quite a lot of work in one way or another, I always did what I could to discourage its use as a cylinder lubricant, but sometimes with very indifferent success. Among our regular customers was a refining company and one of our duties was to answer all calls from them promptly. When the benzine tank is full and the benzine pump goes on a strike they want a man, and want him at once. Their patience is not very great when the agitator is full and the blowing pump or the acid pump gets to thinking it is time for a day off, while to have the tar pump refuse to start when the tar still is on fire is more than a straw tending to break the camel's back.

Of course, all these things are preventable, and of course the man who comes up to fix things should be able to have things go in spite of any stupidity on the part of those who handle them between times, and of course all this is rubbed into him pretty hard whenever he does come up.

One of the hard things to get some people to see is that "circumstances alter cases." A lubricant that never gave any trouble with a pump with flywheels and a plain slide valve can do all sorts of tricks with a direct-acting pump with lots of little crooked ports and passages that must be kept clean, and I soon found that much of my work was finding which of these ports were closed and devising ways to open them.

In hunting down the trouble with the refining company, I found that all their cylinder lubricant was taken from a barrel of mixture put together by the "treater," who also acted as works manager. Just what this mixture was no one was allowed to find out. It was a secret. To think that it did not possess remarkable qualities was heresy. To condemn it showed a lamentable ignorance of the true action of oils and of the skill and ability of the compounder.

I had been around enough on outside work so that I understood some of those things reasonably well, and would have had very little to say on the subject if it hadn't been that the abominable conglomeration (it takes big words to describe that mixture) produced results that were blamed on me. On several occasions I very emphatically called attention to the condition in which I found things and tried to show the man in charge that different oil should be used if he expected his trouble to stop.

If it had been only the question of cost there would not have been any trouble, but this was a point where he prided himself on his superior knowledge in being able to make such a mixture, and my persuasiveness was not sufficient to get him to go back on his hobby. It is needless to say he was not an educated man, although he knew lots about refining oil.

It isn't very funny to walk a few miles under a blazing sun just to go into a room filled with oil fumes and tear apart a hot pump and try to work a piece of wire through all the ways the steam should go. It isn't much funnier, either, to make the same trip with the thermometer showing 20 below zero and the wind cutting the life out, and all for the same purpose.

The night the tar still got on fire everything was snapping cold. The fire did not amount to much, but in trying to pump the tar out the tar pump refused to work, and early the next morning the owner came in, very much excited. The picture of what might have been in case the fire had been large was held up and we were given to understand that that pump *must* work.

When I got to the refinery my friend the manager gave me another dose of the same kind. Again, I opened up my full battery of denunciation of his miserable mixture in the barrel. It was like going up against armor plate with a shotgun.

I went in to where the pump was, took off the valve cover, cleaned out a spot

about ¼ inch square (I knew just where to look on each pump by this time), put the cover back on, started the pump up and left it with the man who ran it and started back. Time at works less than five minutes.

The manager was not in the room when I started, the pump having been stopped by one of the men outside, but he came after me as I started away.

"Hold on a minute, see here now, I want to see you," he called as he saw I was headed for home. "I want to know just what is the matter. You've had to come up here pretty often. That doesn't matter so much, but we can't take any chances of a fire. There's no use trying to blame it on that oil. I've used that for years." So he had, at first with low-pressure steam, but gradually with higher and higher pressure until now it was about 100 pounds.

"You know you always speak of a pump as 'she.' Well, they like to have a man that understands them come around and pet them a little. They like to receive a little attention, just as other ladies do. You mind how the witches used to come around in the old country?" He nodded.

"You don't find so many in this country, but you have one around here that puts all sorts of notions into these pumps. It lives over there in a barrel in the main pump-house, and I blame you for being its father." And I walked off followed by some remarks far from complimentary.

I wish I could say that he used a different lubricant and was happy ever afterward and never had any trouble with any of his pumps. I am not sure of his present practice, but the last I heard he still had great faith in his mixtures.

W. OSBORNE.

The Morse Chain for Heavy Duty.

Most bicycle riders are familiar with the Morse chain as applied to that machine, and we show a new departure by the Morse Chain Company, of Trumansburg, N. Y., in adapting the same principle of construction to chains for heavy work.

The Morse chain differs from others in that there is no sliding journal or pivot action in the joints. The bending of the chain at the joints is by a rolling pivot, and the leading claim made for the chain is that as this pivot is without sliding friction it is practically without wear, and consequently the chain retains its length and pitch under prolonged use.

The construction will be most apparent from Fig. 1. Inserted in one end of the link are the hardened steel cross pieces or bolsters *a a a*, while in the other end are the hardened rolling fulcrum pieces *b b b*.

In the bending of the chain around the sprocket these pieces roll or rock upon one another, but do not slide. The contact of the pieces with each other on this fulcrum surface takes place, however, while the chain is on the sprocket only. By a beautiful piece of ingenuity the surface in contact is largely increased as soon as the chain is straightened by the pull when leaving the sprocket. Alongside the fulcrum surface is a flat surface *c*, which is so made that when the chain becomes straight the contact is on this substantial surface. Moreover, not only is the surface of contact much increased by this device, but the flat surfaces under heavy compression obviously act to prevent vibration of the chain. Another feature of this form of joint is that the length of bearing is the entire width of the chain less the outside links, whereas with pin-jointed chains the length of bearing in each direction is necessarily but one-half the width of the chain.

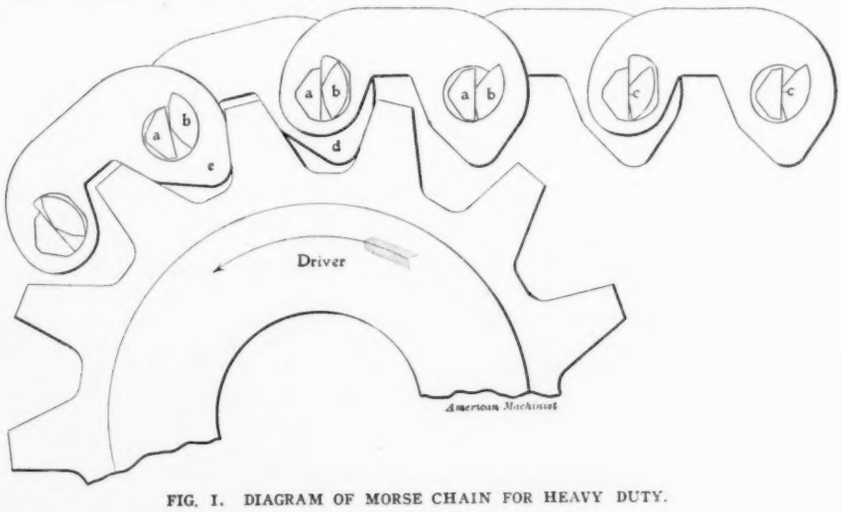


FIG. 1. DIAGRAM OF MORSE CHAIN FOR HEAVY DUTY.

When a link enters the sprocket another highly interesting and favorable action takes place. The compensating angular toothed sprocket which provides for micrometric variations in the pitch is used with this chain and, because of this, fair contact between every link and its sprocket tooth is insured, and each link which is in engagement carries its share of the load. The result of this is that the load on the joints is progressively relieved after the engaging position *d* is passed. In other words the fulcrum surface is subjected to the full pressure due to the load only during the time in which it is passing from position *d* to position *e*.

Fig. 2 is from a photograph of a piece of chain with parts of two links removed, and shows the bolster and fulcrum pieces in position. This illustration also shows the manner in which the chain is kept in position sidewise on the sprockets. The sprockets have no flanges, but the central links are made to project beyond the others, these projections running in grooves turned in the sprockets. The sprockets may thus be but a trifle wider than the chain.

Fig. 3 shows a set of power-driven condenser pumps in the Westinghouse Air Brake Works, which were formerly driven by a pair of gears of 12 and 48 inches diameter respectively by 5 inches face. The gears were removed on account of objectionable noise and the chain drive substituted. The sprockets are but one-half the diameter of the gears, but the faces were increased to 6 inches. The maximum pull on these chains is over 10,000 pounds. In other cases the chains have been driven up to speeds of 2,000 feet per minute. They are made in various pitches capable of carrying from 120 to 500 pounds working load per inch of width.

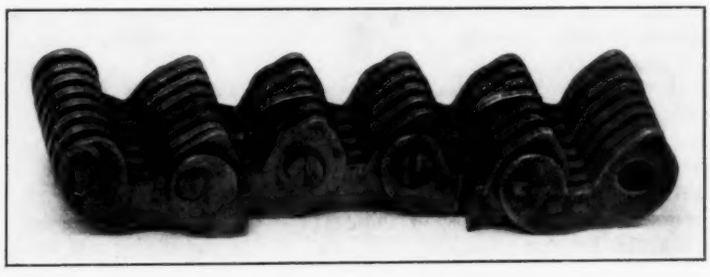


FIG. 2. VIEW OF COMPLETED CHAIN.

Casting Car Journal Bearings.

BY C. VICKERS.

Car journal bearings, or car brasses, as they are generally called for short, are an important part of the car equipment, as upon their anti-friction qualities may depend the safety of the train. These bearings are made of brass or bronze, and are lined with a white metal. They vary in weight from 9 to 25 pounds each when "filled," the lining metal being sold with

the brass at the same price. It is bought back, when worn out, as scrap, at the price of the brass, consequently shrewd manufacturers used to hollow out the bearings as much as possible, and many tricks were resorted to, in order to work in the cheaper white alloy in place of brass. When the bearings were returned as scrap the lining had largely disappeared, so that such scrap being mostly brass the makers could afford to pay the same price per pound for it as they received for the new bearing. Such bearings were known as shells, and are still manufactured, although they have been largely supplanted by the "solids," which have a smooth bearing without any holes or cavities. They are bored in a boring mill, and then lined with a thin coat of babbitt, which is retained by soldering. The "shell" is merely a shell of brass, the bearing of which is made to conform to the curve of the journal by the filling of anti-friction metal; the object of the shell is to provide a bearing whose surface is composed of both brass and white metal. With this end in view, one type of shell has several ribs running obliquely from side to side of the bearing. After lining, these ribs are concealed, but when the lining wears away, the tops of the ribs are exposed, and thereafter that bearing is composed of brass and white metal alternated.

The same result is accomplished in another type of shell by dovetailed cavities in the bearing; these are produced by suitable cores arranged in such a manner that the bearing before lining bears a close resemblance to a union jack. The bearing being lined, these cavities are filled with white metal with the same result as the ribbed shell, with the difference that the white metal is more firmly held by the dovetailing. There are many other types of the shell, but the foregoing are typical.

Car brasses are generally cast with the bearing in the cope, that being the easiest way of making them. Occasionally three of the small and medium sizes are molded in one flask, but the best plan is to have the flasks of a size sufficient for two patterns only.

In hand molding, the first thing that demands attention is the "match." In making this, the patterns are first placed on a board with the bearing down. The nowel being adjusted over the patterns, strips of wood ½ inch in thickness are placed under its edge, raising it to that hight above the board. It is then rammed with sand, and inverted. By placing the sticks under the nowel before ramming, the patterns are raised ½ inch above the joint of the flask. The object is to lessen the amount of hanging sand over the bearings and decrease the liability to "bad lifts."

When making the joint of the first flask, from which it is intended to make the match, care should be taken to round off all sand corners, and to carry the joint down sufficiently deep at the beveled ends of the patterns.

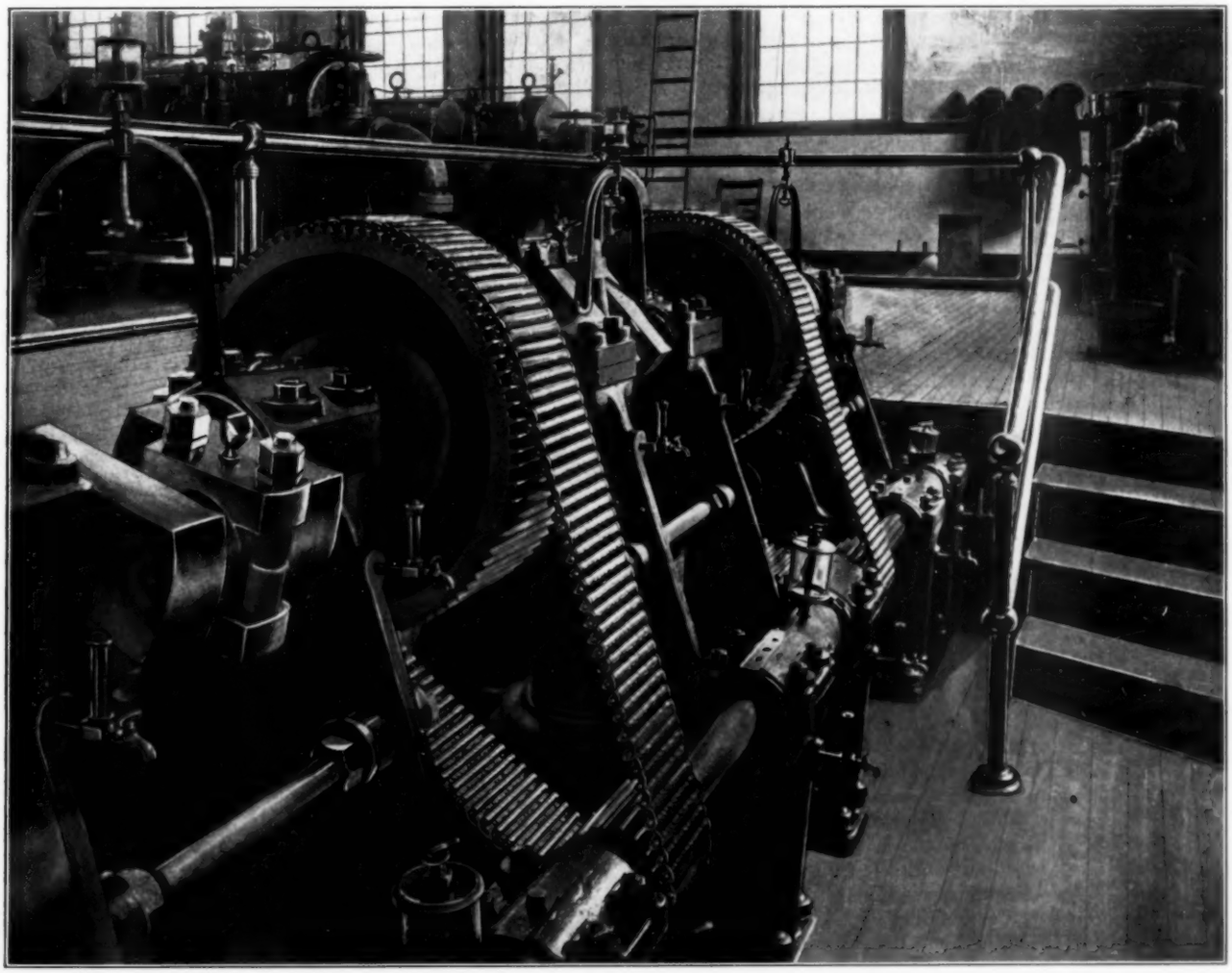


FIG. 3. CHAIN DRIVE FOR CONDENSER AIR PUMP.

For a permanent match, plaster of paris, oil sand or pitch composition are all good and will last; but when a temporary one is wanted, new sand mixed with a quantity of flour is generally used. When the match is rammed, nowel and match are rolled over and the nowel is lifted off. The patterns and a large portion of the sand will stay on the match; this is removed and the match is well nailed wherever it is likely to break away. The patterns are then lifted off and the sand in the center of the bearing is cut away level with the joint, to lighten the match, and

so largely prevent a "drop out." Very little finishing is done on these molds. After the match is finished, the patterns and "set gate" are placed thereon and the nowel is rammed with sand and rolled over, parting sand is sprinkled or dusted on and the cope is adjusted and rammed and then lifted off. The patterns are swabbed, rapped and withdrawn. Loose crumbs of sand are puffed out of the mold, which is then closed and is ready for casting, no flour being used thereon.

Machine molding has superseded hand molding to a great extent in the manufacture of car brasses. The stripping plate machine is quite commonly used, and with good results. Two machines are necessary to form one mold, the nowel being made on one and the cope on the other, and the time required to make one mold with two men is about one minute. One man on the machine, making both copes and nowels, pouring off, cutting over his own sand and removing the castings as the helper shakes out, can accomplish as much as two molders making the same castings by hand and work no harder, so the advantage of machines for this class of work is apparent. One set of patterns will occasionally serve for two different sizes of brasses. Thus the 4x7-inch patterns are used also for the 3¾x7-inch by simply changing the size figures on the backs of the patterns and boring out the castings to the required size. The stripping plates are avoided on another type of machine, which is provided with flask-lifting and rapping attachments.

A convenient size of crucible for pouring car brasses is a "hundred," which will hold 300 pounds of brass. This will cast from five flasks of the 5½x10-inch solids to fifteen flasks of the 4¼x8-inch shells, the average number of molds poured at one heat being twelve.

The alloy used should be sufficiently hard to wear well, and at the same time it must possess the strength requisite to withstand the rough usage to which the journal bearing is subjected without breaking. Bearings for passenger coaches and refrigerator cars are generally made of a good quality of bronze. Some companies specify the proportions of the alloy to be used for both brass and babbitt filling and test the castings by analysis, but the majority of car brasses are largely composed of yellow brass. A mixture very often used consists of 50 per cent. yellow ingots and 50 per cent. car brass scrap. The yellow ingots are obtained by melting down light-yellow scrap, which produces a much harder metal than a new mixture of copper and zinc, and is therefore better adapted to the purposes of a bearing. When this scrap is used, it should be melted in a crucible no smaller than size 300, and the metal must be kept at a low temperature by frequently filling in more scrap as it melts down, the iron and other foreign matter being constantly removed from the top of the liquid metal by means of a long-handled and perforated iron ladle. Each pot will hold from 700 to 800 pounds of metal, which is poured into ingot molds. These yellow ingots have no advantage in price over heavy yellow scrap. After the labor, the loss of metal and the cost of melting are figured the price of the ingots is about the same, but they are more convenient to charge into the pots, and produce a better mixed metal from having been twice melted.

Car brasses are often tested by the sledge. A metal that is difficult to break, and the fracture of which is dense, with a whitish yellow color, is suitable for ordinary bearings. "New" mixtures, made from scrap copper, seldom exhibit these desirable characteristics, as there is apt to be a large amount of oxide present in the alloy. When broken, the fracture sometimes shows black patches of flaky dirt, the presence of which often causes honeycombing, or the spots may appear as thin flakes of metal separated from each other by a greenish dust. A second melting, however, will greatly improve such alloys, and for this reason it pays to make the ingots.

A new metal for cheap brasses is the following:

	Pounds.
Scrap copper	98
Zinc	45
Lead	7
Scrap car brasses	100
Hard machinery scrap	50
	300

After the castings are removed from the sand, the gates are broken off and the brasses are tumbled, ground, and, if solids, bored to size and then filled. This is accomplished by swabbing the bored part of the bearing with zinc chloride, which is allowed to dry and then they are "tinned" by dipping into melted solder, tin and lead alloy, after which they are fitted to a form, clamped, and the anti-friction alloy is poured into the space between bearing and form.

Shells do not require boring or tinning, the lining being held in place by retaining strips cast on the upper edges of the bearing. A lining metal commonly used is composed of:

		Pounds.
No. 1.	Lead	80
	Antimony	20
No. 2 (cheaper).	Lead	80
	Antimony	10

Sometimes pure lead is used. For passenger journal bearings the following is good:

	Pounds.
Lead	145
Tin	40
Antimony	10

Melt and run into ingots for use as "hardening." For the alloy take 52 pounds of above "hardening" and 145 pounds of lead.

The Odd Arbitrator.

In the Bulletin of the National Metal Trades' Association, H. M. Leland, of Leland & Faulconer Manufacturing Company, Detroit, discusses as follows a phase of the arbitration question:

"In regard to the fifth arbitrator, the writer is even more firmly convinced that he would never yield to such an arrangement, regardless of how serious the consequences might be. If we investigate the methods and internal systems of almost any eminently successful concern I believe we shall find, without exception, that they have gradually developed certain business methods and ways of handling their various departments and certain methods or systems of manufacturing, and these systems and methods have built up a large and prosperous business, and by conforming to these methods, which are equitable and legitimate, their eminent success has been attained.

"Now imagine the absurdity of such a concern as this entering into an arrangement by which some one man from the outside, who knows nothing of these systems or the reasons why they exist, how they have grown up or how imperative they are to the very life it may be of the business; imagine such a man, however honest or competent he may be (and many, many times, I regret to say, both qualities may be fairly questioned), solely and alone, with no interest or responsibility for the business, passing upon the question of whether these systems and methods which have built up this business shall be modified, transformed or wiped out entirely, and after a few hours' deliberation quietly deciding that all the plans and systems resulting from a lifetime of careful thought and skillful application shall be destroyed simply because this man has been chosen fifth arbiter. The proposition is so illogical and suicidal that the writer is unable to see how any competent concern who have given the matter a moment's thought can entertain such a proposition. And yet I regret to say that many manufacturers and employers are being insidiously led along this dangerous road, and complications and precedents are being established which, I fear, will sorely trouble them in the days that are to come. The concerns which we represented at Toronto have just been through this experience, and the agreement which they are now acting under with the men is, as I understand it, one of the results of this same absurd system (the fifth arbiter) which was worked upon them a year or two ago.

"In my judgment, the only arbitration (if it may be called arbitration) which any manufacturing concern can safely engage in, where shop methods, systems and the general conditions are to be passed upon, is a conference composed of an equal number from each side, such as the National Metal Trades' Association and National Founders' Association have often called

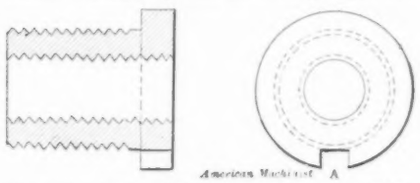
upon. Such a body may reach agreements and modifications of conditions that are in a measure satisfactory to each of the opposing parties, and both sides often go away from such a conference not only having received new light and holding a different opinion than the one held when they came together, but they often go away entertaining a much more wholesome opinion of the merits and justice of the other fellow's side of the case. And if it is sometimes impossible to agree it is certainly better to disagree than it is to have an arbitrary decision made by one irresponsible man which may be very burdensome, if it does not at times seriously handicap or destroy an important and prosperous manufacturing business.

Letters From Practical Men.

Interchangeable Chucks.

Editor American Machinist:

I feel that an article dealing with the interchangeability of chucks will be acceptable to many of your readers. There is often much delay in some machine shops, through not being able to change the chucks readily from one lathe to another. Assuming that in a shop there are



BUSHING THREADED TO FIT SPINDLE HOSE AND CHUCK.

a number of lathes of different makes, there would be a variety of headstock spindles among the number differing in length of screw, pitch and diameter. Assuming that the largest lathe is reasonably proportionate to the rest, we will take this as our standard, using the back-plate as a gage. Take pieces of stock, all the same diameter and large enough to allow for turning and threading to fit this plate, and proceed to bore out and thread so that each shall fit the lathe on which it is intended to be used. Then each piece should be turned on the outside and threaded on its own spindle to fit the back-plate of the standard chuck. It is then cut as shown at *A* for wrench. We shall need new back-plates on many of the chucks, but these plates will soon pay for themselves, as the chucks can then be used on the largest or smallest lathe with equal facility, and each man will have a large range of chucks to work with, when formerly he had only one. MACHINIST.

Birmingham, England.

How to do Neat, Straight Numbering and Lettering With Steel Stamps.

Several years ago I had to do some very nice figuring on a highly polished hard rubber surface. The numbering had to present a neat appearance when finished, and to do so it must be stamped in a line, and each figure or number had to be put on the surface straight or perfectly vertical, so as not to look crooked when finished. After having polished very highly the piece of hard rubber, about 20 inches long by 8 inches wide, taking several hours to do the polishing, the reader will no doubt appreciate what it would mean to make a slip on such a surface.

When stamping a very highly polished surface, it is very difficult to get a stamp properly located, as the surface being very smooth, allows the stamp to slide very easily, sometimes causing scratching. It is customary, when stamping anything, first to set the stamp as close to the position as one can judge by the eye, then give the stamp a light blow with a suitable hammer, in order to make a very faint impression, then raise the stamp to see whether or not the impression is in the right position, and if it is, the stamp is then replaced in that position and given a blow sufficient to make the number or letter the desirable depth. By this method it is very easy to make a crooked impression at first, and also when replacing the stamp for the final blow for finishing the letter or number.

When the hard rubber was polished, I took a piece of thin blotting paper, say 1-32 inch thick, and covered the surface that I had to number with it. (This can be done by cementing or gluing at the corner, the glue or cement to be of such a character that the same can be cleaned off the work afterwards without spoiling the polish or material.) After having fastened the blotting paper, I marked off the places where the stamping had to be done, also marking off the letter or number on the paper, so as not to make any mistake in getting the wrong figure or number on at any place. This being done, I took my stamp in hand, made a slight impression in the blotting paper, then raised my stamp to see if the impression was in the right place and also straight. If it was not exactly straight, I replaced my stamp, using the first impression to guide me in making the second impression, and so on until I had made the correct impression. I then placed the stamp on the correct impression and gave it a good blow, so as to cut through the paper, making an impression on the polished rubber surface. After doing each number, etc., in the above manner, I had a perfect impression of the stamping. I then removed the paper and used the impression as a guide for the final stamping.

This I find to be the quickest, surest and safest method of stamping anything that requires neat, straight and quick numbering, and prevents any mistakes, relieving the person of any doubts or nervous tension as to the outcome of the job. I was puzzled some time before I devised this method, as to how I could do a good job of stamping without making any mistakes or scratches on the work, and was surprised, when I tried this, to find with what ease and safety the stamping was done. This method I would recommend to be used when machine stamping is too expensive, and for special work when hand stamping must be resorted to. H. F.

Editor American Machinist:

Mr. Brandt's letter, at page 1271, relative to a method of stamping letters on metal and getting them in line to appear nicely, tempts me to give a method which I have used a good deal and which I think offers some advantages over his method, or in fact any method I am acquainted with. The scheme consists simply in scribing a very light line with a blunt scriber or scratch-awl, so located as to be at the base or bottom of the letters to be stamped.

In scribing the line a very slight burr is thrown up on the metal, and it is this burr which is used to locate the stamp, which is held lightly in the fingers and slightly inclined or tipped toward the line. Rest the stamp lightly on the work just above the line and gently slide down to the line. When the burr is felt, as it will be distinctly, change the stamp to a vertical position and strike a light blow with a hammer. After all the letters are in and seen to be correct, go over them for greater depth if desirable, and when the burrs raised by the stamps are removed the line may be also. Very satisfactory work is done in this way, and it has the advantage over Mr. Brandt's method of having only two things to handle, the hammer and the stamp. T. H. MILLER.

New Orleans, La.

Boring Jigs on the Miller.

Editor American Machinist:

At page 1114 Mr. Goldsmith describes his method of boring jigs on a milling machine, and while I do not doubt but what that first jig of his was passed all right, I disagree with him when he says that there is no excuse for an error of over 0.0002 inch between center distances.

In the first place, it is very seldom that a milling machine test plug or arbor will run within 0.0004 inch, though of course this error can be allowed for by turning the arbor around so as to measure halfway between the high and low sides. In the next place very few men can read verniers as closely as 0.0002 inch.

Then there is a chance for a slight variation in calipering the plugs and test bar, and taking all these chances together, if the hole comes within 0.0005 to 0.0007 inch it is coming pretty close. In cases where extreme accuracy is desired it is possible to get them closer, but it is considered good work to get them as close as that.

Mr. Goldsmith says, in setting from the table vertically, to set to the right position and then lock the vertical slide or knee tightly in position. Locking the knee after setting will vary it from 0.0002 to

0.0004 inch on most machines, and here is a point I desire to emphasize strongly: Before starting to bore a jig on a milling machine, clean and oil the machine thoroughly and adjust the gib screws so that the knee, saddle and table move with a little tension, not too much but a little, and *don't alter the gib screws again until the jig is bored.*

The holes should be bored to fit a plug smaller than the finished size and measured before the finishing cut is made. Of course such jigs are inspected on a surface plate and there is quite apt to be a slight difference in measurements taken while the jig is clamped down solid and those taken afterwards on the plate.

C. A. HARGRAVES.

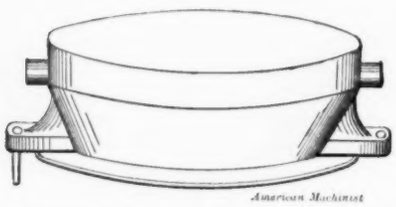
Shaping the Flask to Avoid Tucking.

Editor American Machinist:

I have received many good pointers from the writers in the AMERICAN MACHINIST, and I would be more than glad to be of any service to others.

I have a flask, which I believe is new, for the molding of spur gears on stripping plate molding machines. We have experienced much trouble in getting good gears that were not "swelled" in the teeth, and in thinking of some way to overcome the trouble we hit upon the plan of making the drag with beveled sides, as shown in the sketch. The molders of the class we employ to do that sort of work were apt to neglect the tucking somewhat. I could hardly blame them when I have seen their finger ends all cracked and bleeding from excessive tucking.

The gear I have in mind is 3-pitch, with twenty-seven teeth, and we required about 3,000 of these in a season of about three months, and the molder put up from forty-four to forty-eight of these for a day's work. After making the flask as shown, the same man made sixty-four with considerable less loss, and he said that he would rather make sixty-four with the new flasks than forty-eight with the old ones, as no tucking was necessary.



SHAPING THE FLASK TO AVOID TUCKING.

The sketch seems to me to need little explanation. The bevel should be carried about ½ inch higher than the pattern, which in this case was 2¼ inches, and at the joint it should come as near the pattern as practicable. It will be readily seen that in ramming around the edge of the flask it will have a tendency to crowd the sand into the teeth and accomplish the same result as tucking.

The flange on the joint was put there so that I might use our regular straight copes.

Before trying this scheme I obtained the opinion of our foreman and several other good molders, and their opinions as a whole were not at all encouraging, as everyone said that it would not work; but I was just bull-headed enough to try it anyway, and I am not sorry that I did so.

Another good scheme is to put one pin in the drag and one in the cope, and then the drags may be used for copes, or *vice versa,* and the molder will not have to paw down a whole pile of flasks to find a cope, as I have seen some of our molders do.

GEO. HALEY, JR.

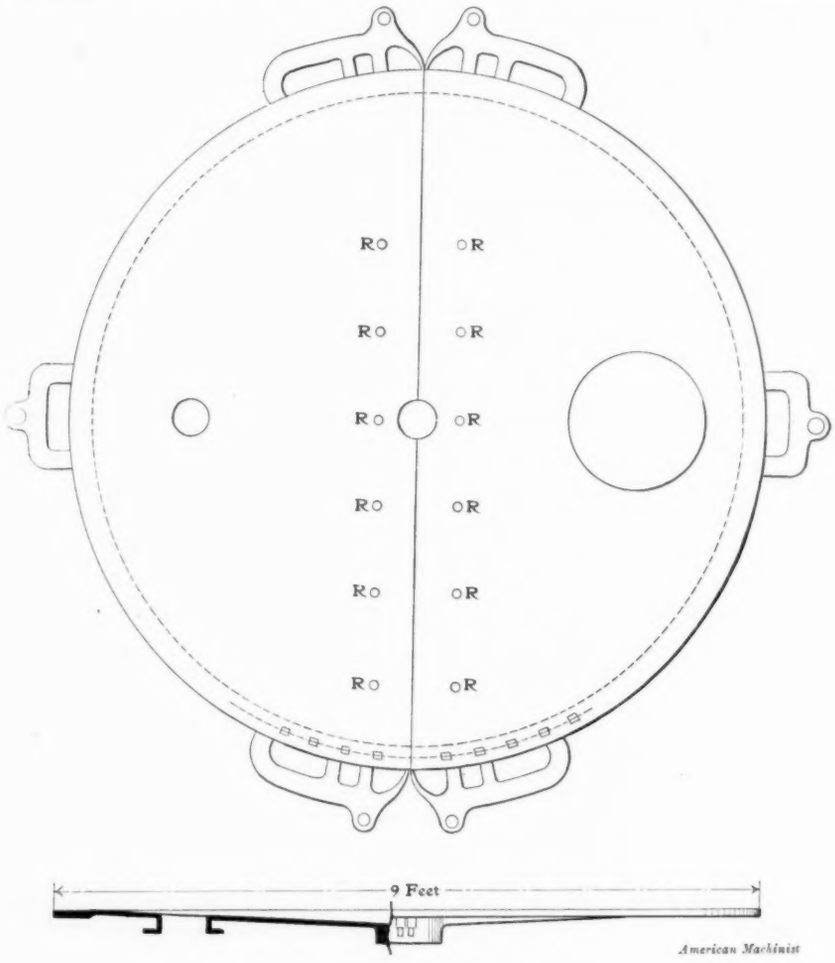


FIG. I. A TANK COVER CASTING.

Molding a Tank Cover.

Editor American Machinist:

Fig. 1 shows a circular tank cover, 9 feet diameter and ½ inch thick. The whole plate is cast at one operation, but is divided by splitting plates, forming two castings. The weight of a cover plate complete is about 1,500 pounds.

The mold is formed by sweeps, and the various pieces of pattern, the splitting flanges and the small branch shown in the section are bedded in as the mold is formed.

When commencing on a job of this kind great care is necessary in arranging the holding-down tackle. In the sectional view, Fig. 2, the holding-down arrangements are shown. *A* is a bar which is bedded at a sufficient depth into the floor to allow room for a bed of cinders, and on the top of the cinders about 5 or 6 inches of sand are firmly rammed. The bar *A* and another similar bar are placed parallel to each other about 3 feet 6 inches apart, and on the top of these bars are laid plates. Any old tackle may be used for this purpose; old box parts or core plates answer very well. Hook bolts are placed into suitable staples cast into the ends of each bar. The bolts are firmly wedged up by placing wedges under the hooks in the bolts and wedging up the hooks tight against the staples. The bed for the mold having been formed and the vent pipe *V*, Fig. 2, placed in connection with the cinder bed to ensure a free escape of the gases when the mold is cast, a spindle center is set and the spindle is fixed in a perfectly vertical position by the use of a spirit level.

The sweep which forms the bed on which the top part is rammed is now fixed and a firm bed which will stand the weight of the ramming up of the top without losing much of its shape is formed. Parting sand is sprinkled over the surface to secure a parting, and the top part is placed

in position. This is rammed up and after having been carefully staked it is lifted off the joint. The sweep which forms the bottom of the mold is now used, and after having worked the same around roughly the whole of the bottom face of the mold is vented into the cinder bed and the sweep is used to finish and give the true shape required. At this stage the various patterns are bedded into their respective places, and are in their turn withdrawn and the splitting plates are set and the top part is tried on, some pieces of soft clay being first placed on the face of the mold, by which means the thickness of metal is noted. The running gates are tried when the top is tried on to note that the in-gates are in connection with the down-gates.

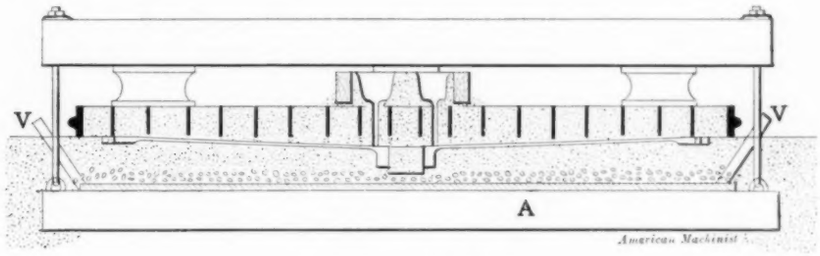


FIG. 2. SECTION OF MOLD.

Fig. 1 is a plan of the casting having the running gates attached. This method was found, after trying several others, to answer best for plates of such large diameter and light metal.

The plan, Fig. 3, gives the mold ready for pouring, the main runner having enough gates to take metal into molds ten times the weight of this casting, but not too many to secure a casting of this kind free from cold shuts and other defects common to light green sand castings.

G. BUCHANAN.

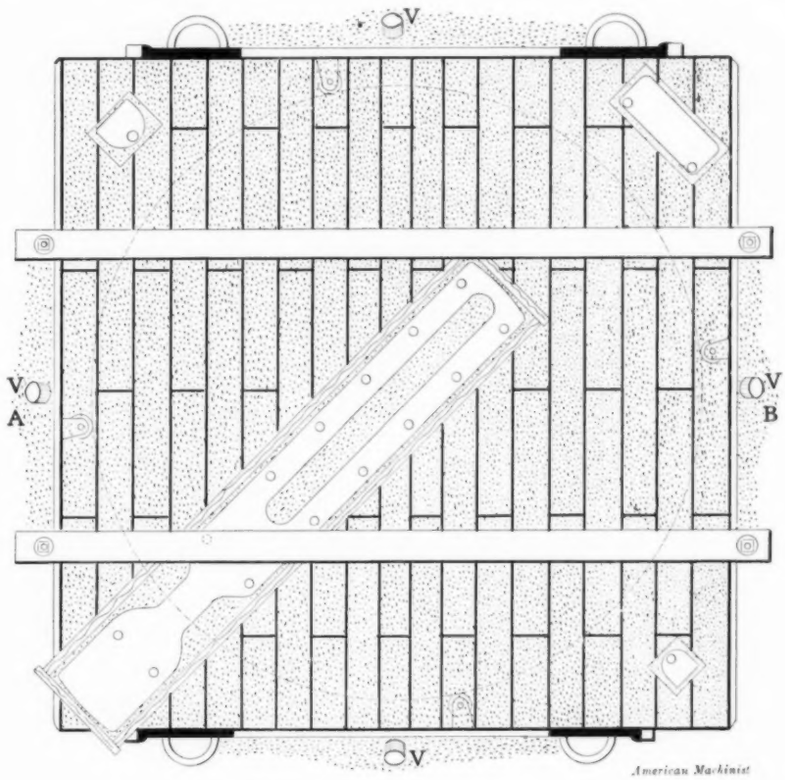


FIG. 3. MOLD READY FOR POURING.

Which is the Best Trade for My Boy?

Editor American Machinist:

A short time ago a lady called at my home with her son, a young man eighteen years of age, to ask my advice as to the best trade for him to learn.

Said I: "I don't know any question you could ask me that would be more difficult to answer, but I will try and answer it by relating my start at the trade and how it came about. From this you can draw your own conclusion.

"When I was eighteen years of age I left school and started to work for my father. I worked for him one year. The work was such as laborers do and required my presence constantly, but it was such that I had some time to devote to study or work for myself. Anything in the mechanical line caught my fancy, and I was continually making something in wood—windmills, wood engines, boats, etc. One day I thought I would make a bird house, but I was stuck for the lumber. I didn't want to spend my money (a nickel was a lot of money to me then) for anything but tools, nails, etc.

"About this time the popular way of advertising was by small printed boards. These boards were nailed to barns, fences, etc.; the size of the boards was ½x8x36 inches. When I saw the man nailing the boards up it struck me at once where my boards would come from; so one night, when everyone was in bed but the cats, some of the boards were missing.

"Well, I made the bird house, and it looked quite neat and mechanical. Nearby was a large manufacturing concern, and the superintendent was a friend of my father. He saw the bird house and, calling my father, he said, 'John, who made that bird house?' Said my father, 'Oh, the young fellow has been tinkering around the past two months at that, and I am glad it's out of the way.' 'Well,' said the superintendent, 'this is no place for that boy; I will call for him to-morrow, and you see that he is ready. I will take him in to a shop where he will learn a good trade.' That was how I got my start at a trade that I knew nothing about; but after close attention and hard work I made a grand success, I am pleased to say.

"Now, the superintendent picked out a trade that is a good one and which I was fitted for, because he saw my work and my inclination, which the advisor must understand. I tell all this just to show how it came about that I started at my trade. Had I taken the advice of my father and others I would have learned a trade which now would not give me a living if I followed it.

"At the time I started I had had a young friend of my age. We were constant companions. He told his mother of my good fortune; she was much pleased and wished that her son could start with me, but she, being poor, could not let him start at the trade on account of the small pay. He started to work for a large furniture house, washing windows; to-day he is manager for the company at $4,000 per year.

"The right man at the right trade is all right; but the right man at the wrong trade is deserving of pity. So you can see, Mrs. ——, that it is a difficult matter for me to advise your boy the trade to learn."

D. E. M.

A Case of Chattering Cured.

Editor American Machinist:

In the varied experience of the machine shop in doing all sorts of jobs in all kinds of ways it is sometimes expedient to go back to rather primitive methods and devices.

A circular disk of cast iron nearly 4

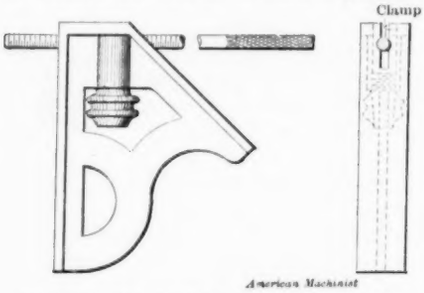
feet in diameter and about ⅜ inch thick, strengthened by a series of supporting ribs, had to be faced off. The requirements were for as smooth a surface as possible. The work was put on a lathe having the usual back gear and a geared face-plate. The usual form of facing tool was used, but it "chattered" very badly. Other forms were tried, various angles of top cut, cutting edge and undercut were put in, but to no purpose. The bearings of the lathe were carefully examined and set down as closely as practical to run, but still the work was far from what it should be. It had come to be the conviction of nearly everyone connected with or interested in the job that a heavier casting would have to be made, when one of the "old-timers" suggested throwing out all gearing and running a driving belt on the rim of the face-plate itself. The plan was tried and the job was done with no further trouble, and an excellent surface was produced. Almost any of the numerous tools previously tried would do fairly good work with the belt drive. Apparently the slight jar caused by the gears produced sufficient vibration in the thin plate to spoil the work. This feature was eliminated by the use of the belt directly on the face-plate, thus bringing the power and the resistance as closely together as possible.

P.

A Combination Square and Depth Gage.

Editor American Machinist:

I send herewith a sketch of a depth gage attachment to a combination square. The gage rod is made of ⅛-inch Stubs steel and may be 6, 12, 18 or 24 inches long. The hole drilled in the square head to receive the rod is in such a position



COMBINATION SQUARE AND DEPTH GAGE.

that when the blade is removed the gage rod can be inserted without turning the clamp nut. The changing from square to depth gage is done in an instant. In the large square heads I use a graduated 3-16 inch rod 12 inches long. I also use this rod for a marking gage, the whole thing making a very neat and useful combination tool.

M. E. DUGGAN.

Drawing Strips of a Long Pattern Endwise.

Editor American Machinist:

The lathe bed pattern, as shown by Fig. 1, had been sent in by a customer. It was a new pattern, and, not noticing anything amiss or unusual, the molder had got it rammed up, and the central green-sand core removed, when he found that the strips would not come out, for the distance *A* was greater than *B* and the strip thus touched the other strip before it was clear of the corner *A*, Fig. 2. They didn't know what to do, and finally decided to try to spring it out and trust to having a little mending up in an awkward place. When

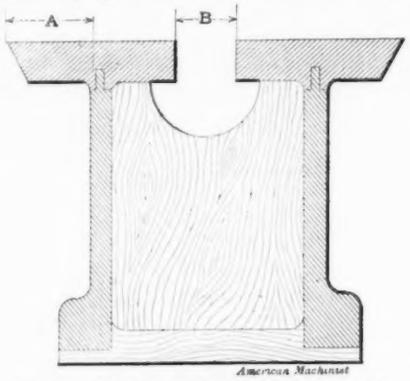


FIG. 1. SECTION OF LATHE BED PATTERN.

I arrived on the scene I asked "what's up?" "Look how some fool of a pattern-maker has made this pattern." I said, "It strikes me that the patternmaker knew what he was doing. If he had made those strips in two pieces instead of each in a single piece, you'd have got them all over the shop." "But we can't get them out." "How's that?" "They're too wide to come up." "Well, why get them up?" "We can't get them down." "Is that the only way to get them out? Why not get them out endways? Cut away the end of the mold, draw the strips, and then mend up again. That's how the patternmaker intended it to be done. He evidently understands a thing or two that you don't." As a general rule, we find that however

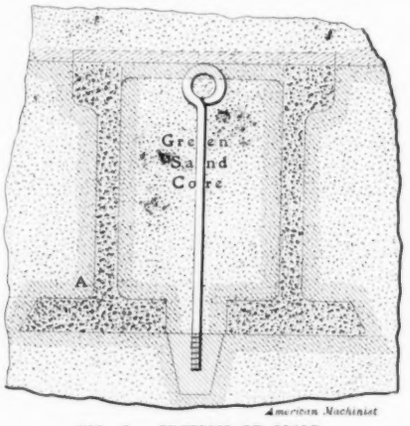


FIG. 2. SECTION OF MOLD.

ingenious a patternmaker may be, it won't do for him to exercise his ingenuity, for the molder won't understand it. I'm speaking in a general sense only; he whom the cap fits only may wear it. Often have I seen patterns made to mold a certain way, when a little departure from the cut-and-dried methods in molding would have saved many a dollar both in the pattern-room and in the foundry itself.

FRANCIS W. SHAW.

Birmingham, England.

Dynamiting Scrap.

Editor American Machinist:

There is a plant located up a branch of the Pennsylvania Railroad near Monongahela City, Pa., that has a continual Fourth of July celebration of its own, and anyone within a mile or two of it hears nearly constant cannonading, and while an interesting place, yet it is shunned by ladies and timid persons generally. This plant is composed of two units or duplicate plants about one-eighth of a mile apart. At each place the power plant consists of a boiler and engine to run the shafting, and a twist drill grinder, also a hoisting engine. The shafting has sheave pulleys on it, and out in the yard are a dozen or so portable drills, each one mounted on top of a casting or forging and held in place by a chain running around the piece. The drill is driven by a round belt from the line shafting, and, being self-feeding, all the operator has to do is to pour on the lubricating compound and smoke. The article being drilled is flawed or condemned material, either cast iron or steel that has cooled off in ladles, and the object of drilling the holes is to insert dynamite to break them up into convenient sizes for easy remelting.

When I was there they were breaking steel. They drill a row of 1¼-inch holes, about 8 inches apart, across the face of a nickle steel ingot (that was intended for armor plate) and about 16 inches deep, and then by means of a jib crane lower the piece into a pit about 18 feet square, dug in the ground 12 feet deep and lined with oak timber 2 feet thick. After lowering it the dynamite is put in each hole, tamped tight with clay and six or eight shots are all fired at once by means of an electric battery. Before firing the shot they cover the top of the pit with a railroad iron cover bolted together to prevent flying particles of iron or steel. The "boss" blows the steam whistle like a fire alarm, looks around the place to see that all are out of danger, gives a shout of warning, touches the button, and you would think a brick was thrown against each side of your head at once.

After raising the cover they sometimes find the steel is not even cracked, and ingots of nickel steel have withstood six of these terrible shots before breaking. They use twist drills to drill the holes, and the boss has to swedge out the drills and temper them often, as the clearance is soon worn off in drilling holes so deep, and as the drillers are generally "Dagos," you can imagine that he has troubles of his own. The engineer operates the hoisting engine, fires the boiler, oils the drill presses and grinds the drills on a drill grinder. It is rather amusing, when you first approach the plant, to see the dozen drill presses perched up on what look like rough stones, and some even in a flat car on the railroad siding, all drilling holes at various angles.

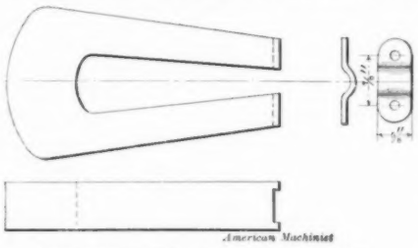
The company has all it can do, and

months of work ahead, and will break up anything you may send them, into any size of scrap, charging for it by the ton of broken material. I had a 12-foot flywheel, with a rim 6x8 inches, solid, to break up, and after visiting this plant and seeing the effects of dynamite, I tried this method of reducing it to cupola size. We first lai the wheel on wooden blocks, made some mud balls like you use for babbitting with, placed one-fourth of a stick of dynamite on the top side of the casting, put a "cap" and 8 inches of fuse in the dynamite, covered it with clay, leaving the fuse projecting, lit it and ran. After the report the rim was broken, and it just took three-quarters of an hour to break this entire rim into pieces, none of them over 18 inches. I do not think a "drop" would have done it as quickly, if we had one, and I give this information for some fellow founders who have purchased scrap and want to break it cheaply and well. Of course there is some noise connected with this, also danger—not from flying metal so much as from premature explosion—but with good fuse and care no harm will result. MONONGAHELA.

Holding Work With a Magnet.

Editor American Machinist:

Having a great many small steel punchings which are plated and then buffed, it was found that being so small it became necessary to make a jig for holding them against the wheel. A magnet suggested itself as being the proper thing in this case and, accordingly, a piece of tool steel was found in the scrap pile having the shape of a horseshoe coming out of a transformer core die, and its poles shaped out so that the piece would fit therein. The steel was then hardened and drawn to a straw color



HOLDING WORK WITH A MAGNET.

and magnetized by placing in contact with a powerful electro-magnet.

The device worked very satisfactorily, and we are expecting to utilize the principle for other small steel pieces.

GEORGE DRACHUS.

Supports for Tool Work.

Editor American Machinist:

Many devices so familiar in some shops as to be taken as a matter of course may in other places be looked upon as novelties, by the younger members of the trade at least, and it may be that the accompanying sketches show ideas of this class.

Fig. 1 shows a support, for delicate or accurate work, that is better than the jack-screw or wedge. It consists essentially of a pin, perhaps ¾ inch in diameter, having a hole drilled longitudinally from the lower end to about the head. A V-shaped groove is cut from the lower end to the head and into the drill hole, the groove having an included angle of about 60 degrees and taking the point of a special set-screw

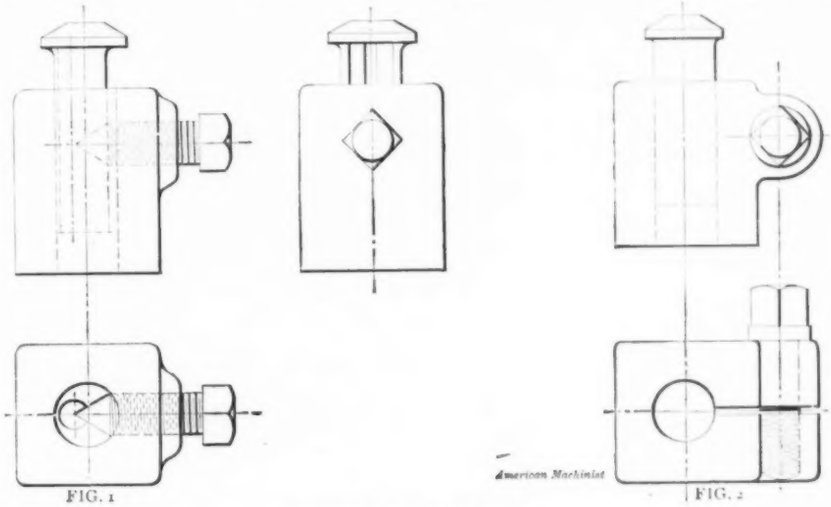


FIG. 1 FIG. 2

SUPPORTS FOR TOOL WORK.

tapped into the base block. It is evident that this screw will expand the pin when set against it, and hold it where required.

The head of the pin offers an easy means of lifting the pin into contact witn the work. The hole should be of rather large diameter to allow the pin to spring open easily and the screw should bear heavily near the outer edge of the groove for the same reason.

Fig. 2 shows another form of a device for the same purpose. It is simply a pin with a head as before secured in the desired position by a binding screw which closes the split block, as shown. In either device it is essential to have a good hole in the block and a good fit for the pin if maximum holding power and ease of tightening are desired. Any suitable block for the base may be used, or the pin may often be incorporated in a fixture for holding the work. In the latter case Fig. 1 may be the more useful, as it is often desirable to put a support where a saw cut cannot be made or is not wanted. With either of these devices the springing tendency found in jack-screws and wedges is avoided. F.

Filing the "American Machinist"—Handle for a Needle—Tap to Hold a Scale.

Editor American Machinist:

The AMERICAN MACHINIST is in my humble opinion too good a paper to give away as soon as it is read, and a nuisance when the numbers are allowed to lie around the house loose, to be finally piled up in some out-of-the-way place, in perhaps anything but their regular order; yet even such a condition yields the satisfaction of knowing "they are all there," while at the same time one is conscious of the trouble to be encountered when using them for reference. I have arrived at a method of keeping the papers half way between the one just described and those nicely bound volumes that you give away for $5.00.

First make a small sheet-iron templet or jig with six holes and three legs turned down, as shown in Fig. 1. After having torn off the "ads.," clamp about eight numbers at a time, with the templet on top to a board, using the lugs as stops to locate the templet, and also to keep the numbers in place. Then, with a brace or in a drill press, drill the six ⅛-inch holes through all the numbers thus clamped, and tie them

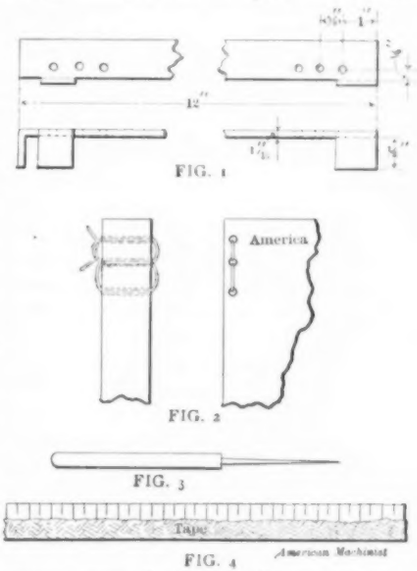


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FILING THE "MACHINIST"—HANDLE FOR NEEDLE—HOLDING A SCALE.

together, as shown in Fig. 2, with strong string or wire in half-yearly bundles with the index on top of the first number. When done this way they stand nicely on edge and can be handled as conveniently as a well-bound book.

. . . . . .

We have read before in these pages that

an ordinary sewing needle makes a first-class and cheap scriber for fine work, but for a deep hole, as in die work, it lacks a handle and stiffness. A good way to provide for these is by taking a piece of 3-16 inch brass wire about 4 inches long and drill a hole in the end large enough for the needle to drop part way in and then to solder the two together. If things in the shop are at all handy it is but a moment's work to replace a needle and the holder will last forever. See Fig. 3.

. . . . . .

Everyone who has done nice laying out knows how the straight-edge slides about just when you are ready to scratch a line, and how often that simple job takes two

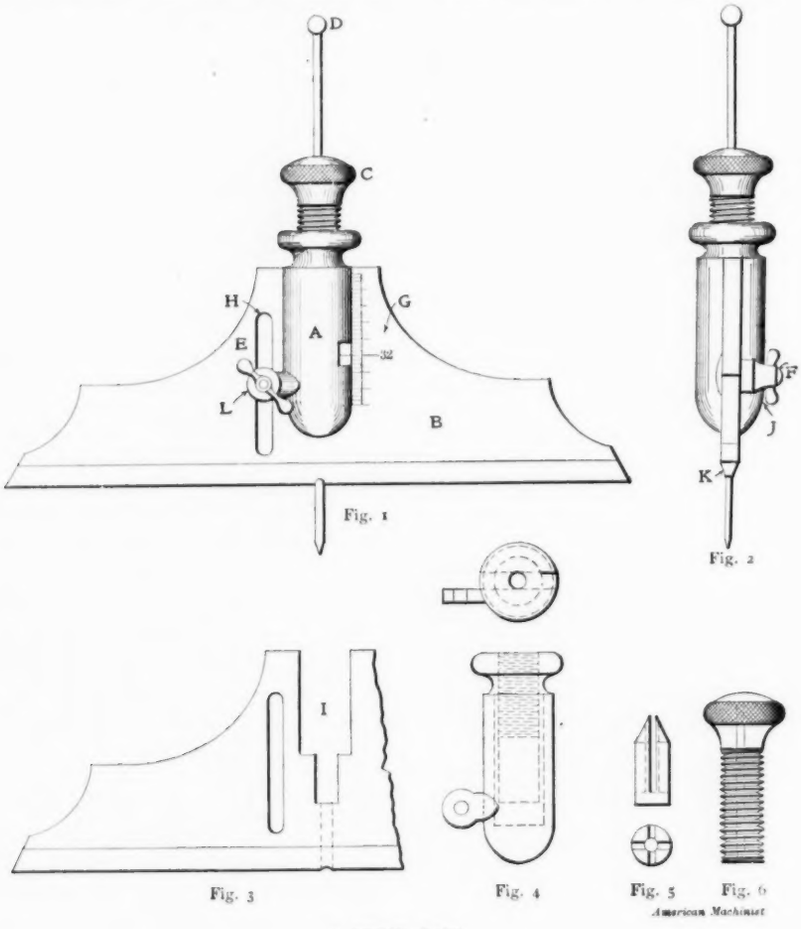


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6

American Machinist

A DEPTH GAGE.

pairs of hands. This trouble can be quickly overcome by taking a piece of electrician's tape and wrapping it once tightly around your scale lengthwise, so that it will still leave half the graduations in view, Fig. 4. If the scale is a short one, a rubber band does better still. Then only the slightest pressure is required to keep the thing exactly where you want it.

WILFRID J. THOMPSON.

A Depth Gage.

Editor American Machinist:

This gage is designed for tool-makers, die-makers and machinists. If you study Fig. 1 carefully, you will see that the tool is not of the ordinary depth gage construction, but that it is made in such a manner that the barrel *A* can slide up or down in the slot in the beam *B* when the thumb-nut *E* is left loose. The locking device at the left of the barrel makes the tool either adjustable or positive. The scale *G*, at the right of the barrel, makes the tool a ready reckoner; for example, if a man is drilling a hole to a given depth and cannot see the bottom of the gage, he can set the needle *D* to the required depth and lock clamp screw *C*, leaving lock-nut *E* loose; then, if the hole is too shallow, the barrel *A* will slide up the beam and the scale will show how much stock is yet to be taken out.

After you once set the needle *D* and clamp it with screw *C*, the depth measurement is not changed by the movement of barrel *A* on the beam, for, when the barrel is pressed back in place, the needle is returned to its original position. Referring to Fig. 2, you will see that the edge of the beam is round, as at *K*, making only one point from which the proper depth of the hole can be gotten. On the average depth gage this edge is flat and if you tilt the beam you increase the measurement, but with that tool the error is obviated. In this view, *F* is a button head screw slotted to fit the slot *H* in the beam, and J is a washer under thumb-nut *E* and overlocking arm *L*.

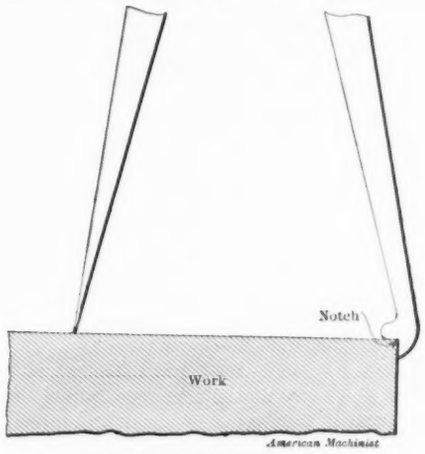
Figs. 3, 4, 5 and 6 show in detail the most important parts of the tool. The slot *I*, in Fig. 3, controls the action of barrel *A*. Figs. 5 and 6 show the spring collet and the special screw for clamping the needle *D* in the barrel. This, I think, is a tool that fills a long-felt want.

WM. J. SHARP.

Improved "Morphidites."

Editor American Machinist:

I find it very unhandy and unmechanical to draw a line or locate a center with the ordinary centering caliper. The sketch shows, with a slight improvement, the ordinary "morphidite" caliper. A notch is filed in the bent leg which forms a guide and rest when marking or laying out work



IMPROVED "MORPHIDITES."

from a corner. A number of my fellow workmen have fixed calipers in this way and say they could not now work without them.

MACHINIST.

Steel Frames Instead of Wood Slip-overs for Snap Flask Work.

Editor American Machinist:

One of the objections to snap flask work is the rapid destruction of the wood slip-over frames. Four months ago we tried a new wrinkle in this line which has proved so successful all around that I thought it might prove of interest to some of the foundry readers of the AMERICAN MACHINIST.

For a snap flask 6 inches deep, 11 inches wide, 14 inches long, 2-inch cope, 4-inch nowel, make of 1-16 inch thick soft steel, 4 inches deep 11 inches wide outside and 14 inches long outside, as many frames as you want molds. Bend at the four corners and rivet together.

After placing the pattern on the face-board next place on your steel frame, now put on your snap flask, nowel part. Ram up, place on bottom board; turn over, finish the mold and remove the snap, leaving the steel frame right on just where you need it without any further work or trouble. When most of the mold lies in the cope, place the frame on the cope side instead of the nowel, and you don't have to worry about slip-overs, or have them made every few days, or lose a rush job

from a run out. Four months' use of these frames has proved that they are cheaper than wood, being indestructible, and, besides, we now get 20 per cent. more good castings in the bargain—and the first cost is all. We have discarded all wooden frames and now use nothing but sheet metal. They can also be made of cast iron, about ¼ inch thick, but after several trials we chose sheet metal on account of lightness. C. NEIL.

Fastening Boring Cutters.

Editor American Machinist:

The boring bar and cutter and also the cutter boring and turning chuck here shown are not presented as strictly new,

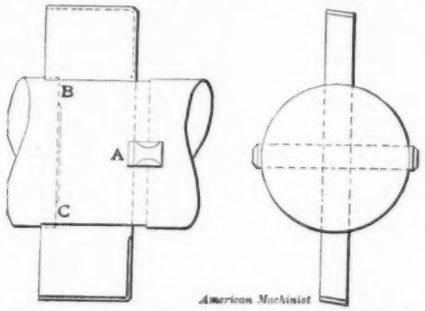


FIG. 1. FASTENING CUTTER IN BORING BAR.

although they may be new to some of your readers, especially the manner of holding the cutter in the bar, Fig. 1. The boring bar is slotted in the usual way to receive the cutters. At right angle to and at the front or cutting edge of the cutter a cross slot is made in the bar for a taper key. The key has a bearing on the cutter at *A* and the cutter bears at *B* and *C*. This is as it should be, for when the key is driven parallel with cutter, as usually done, unless it is a good fit the cutter leaves its seat in the bar (on one side) and trouble begins.

Fig. 2 shows a cutter boring and turning

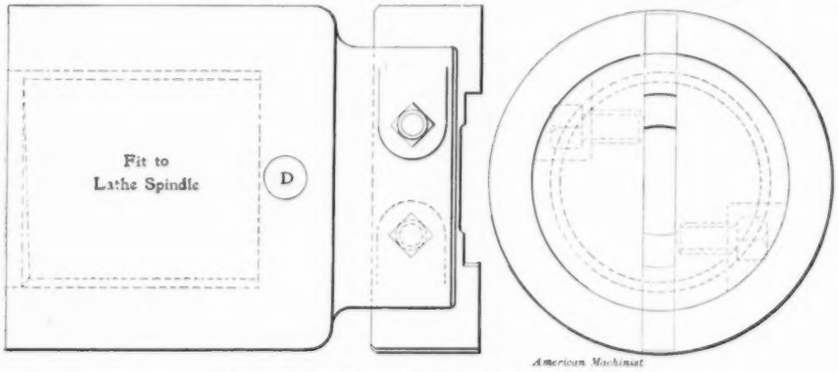


FIG. 2. FASTENING CUTTERS IN BORING HEAD.

chuck. I think it will be readily understood without much explanation. A piece of cast iron of proper dimensions is bored and threaded to suit the lathe spindle. A slot is made central and across the outer end to receive the cutter, which is held in place by set-screws, as shown. A hole should be drilled at *D* for removing the chuck from the lathe spindle. The center of the cutter is slightly cut away to give the bearing at *B C*, as in Fig. 1. Of course a chuck should be made for each *thickness* of steel used. In making these cutters I first bring them to the thickness and then plane the edge, so as to have a correct bearing in the chuck while being bored and turned. I then block out in the shaper, to somewhere near the size of the bar, all the cutters I desire to make at the time. The turning and boring of the cutters is then a small matter. The cutters must of course be backed off after turning. By this practice the boring bar need not go to the toolroom to have cutters turned, and cutters of all sizes and for all bars may be made up and kept in stock and checked out the same as other tools. I have been in charge of machine tools for some years, but unfortunately I have always been engaged with those concerns that had boring bars and cutters that had done very well for years, and the superintendent almost always says, "I don't like to throw them away." If I should go with a new concern I would insist that every cutter of a certain size should fit every boring bar using that size, or, in other words, all cutters should be interchangeable.

Helping new men to get started, finding keys (that would not fit), shims, such as sheet iron, tin, etc., has been the cause of most of the gray hair coming on my head while yet so "young and innocent." The bar and cutters, as shown, will overcome most of this and make the life of the foreman one continuous round of pleasure.

BECK.

Cast Iron Step Chucks.

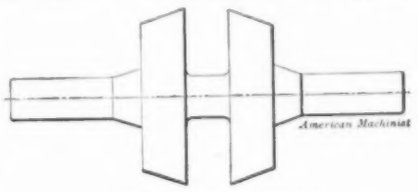
Editor American Machinist:

A few cast-iron step-chucks or drawback collets, as many call them, added to the bench lathe or toolroom engine lathe outfit will set one wondering how he ever did without them. They will more than take the place of the expensive steel step-chucks for all toolroom or jobbing purposes, and will hold their own on many manufacturing operations.

The patterns are made like sketch. The castings should be of a good close-grained iron, each casting making two chucks. After facing the head on both sides, the body and angles are turned and filed to fit. Now cut the threads and mill the keyways and the blanks will go into the lathe where the holes are drilled in from the back of each chuck before cutting apart. Complete the holes from the front after cutting apart, if they are not drilled clear through, and saw the three slots, using a saw about 3-64 inch thick.

In opening, put a small piece of sheet stock of the same thickness as the saw in each saw scarf, drawing the chuck down lightly, and using care not to spring it.

It is easily seen that these chucks are cheap to make, and are practically a special chuck for each job. Of course, a set of regular sizes would come in handy, but



CAST-IRON STEP CHUCKS.

on jobbing and where accuracy enters largely it is better to open out a chuck for the job in hand. WHEELER.

Facing Large Pipes in the Lathe.

Editor American Machinist:

We had to face the ends of six cast-iron pipes. The pipes were 42 inches in diameter inside, had flanges 50 inches in diameter and were 10 feet long. The only machine in the shop large enough for this work was a 60-inch Schellenbach pulley lathe, and this had to be moved out of place because of a column at the end. After getting the machine set again the tailstock was removed. As we had no crane to handle the pipes we had to roll them off from the car and on to the lathe.

After getting a casting in place, I bolted an angle plate, fitted with a sliding tool block, to the face-plate of the lathe; this was used to face one end. Two spiders cast from pulley arm patterns were bored and babbitted for a 3 7-16 inch shaft 14 feet long. The spiders were drilled and tapped at the end of each arm for ⅞-inch set-screws. After the spiders were finished they were put inside the casting to carry the 3 7-16 inch shaft.

On one of the shafts was put a regular flanged coupling. The end of the shaft was then turned down to go in the center hole of the spindle to keep the shaft central. The coupling was then bolted to the face-piate and a 3 7-16 inch hanger was placed at the outer end to steady the shaft. For a facing head for the outer end I found a 3 7-16 inch pillar block, on the flat side of which I bolted a piece of 9-inch channel iron 30 inches long. The tool block of a compound rest, bolted to the channel iron, carried the facing tool.

I experienced some trouble at first with the tool springing away from the work, but I overcame that by putting a collar

on the shaft and bracing it from the tool block. With this rig I was able to face both ends at once and was sure that they would be true with each other. This was very important, as the pipes were to be bolted together. W. D. S.

A Turret on an Old Lathe.

Editor American Machinist:

We had an old 30-inch lathe with 15-foot bed which had been thrown aside as worth little more than scrap. We also had a large amount of work which should have been done on a modern turret lathe. It was impossible at the time to convince the management that it would pay to invest the necessary money in such a machine, and, as I was expected to reduce costs, it was "up to me" to do the best possible with the tools at hand.

Among the pieces that were costing too much were the eccentrics and straps for our engines. These were being bored and turned in an ordinary engine lathe at the rate of ten to twelve per ten hours by a full-fledged, full-paid machinist. I found on examining the old lathe that the cone, spindle and back gears were of fairly good proportions and amply strong for light turret work. We moved the legs forward and cut seven feet off the tail end of the bed, thus reducing the floor space required nearly one-half. We planed the ways and refitted the carriage to them and also planed the cross-slide on the carriage. We discarded the apron and all the feed mechanism and substituted a quick pitch screw for feed purposes. We built a turret, as shown by Fig. 1. The turret was 10 inches in diameter and was set in the bed piece and secured by the ring *B* and could be held rigid by the clamping screw *C*. The turret had eight holes bored through to the cored central hole, which was 4 inches in diameter. These eight holes were Mosse taper. The tool holders extended through so that their rounded ends projected into the large hole as shown, thus enabling them to be readily removed. Each tool holder was secured by a set-screw with a copper button under its point. The projecting ring at the bottom of the turret had sixteen notches in which the lock bolt, operated by the lever *D*, fitted. The turret, as shown in plan, is equipped with tools and in the elevation the tools are removed.

I will first describe the operation of boring and facing the eccentrics shown on an arbor, Fig. 2. All the necessary chucks for the work done in the lathe were bolted to a permanent face-plate 20 inches in diameter, having in its face a groove to which the chucks were all fitted. In boring the eccentrics and many other pieces an ordinary three-jaw chuck was used. When rebuilding the lathe we had bored a hole through the spindle 1 11-16 inches in diameter and enlarged the end next to the face-plate to 2 7-16 inches, and bushed it with a hardened steel bushing which was ground true in place.

The tools for boring and facing the piece are Nos. 10 and 11, Fig. 1, and the centering tool is No. 13. The roughing and finishing cutters were in bars like No. 10. The cutter and holder for the rough face cut was as shown in the turret at No. 1. No. 11 shows the tool and holder for scraping the face to a finish.

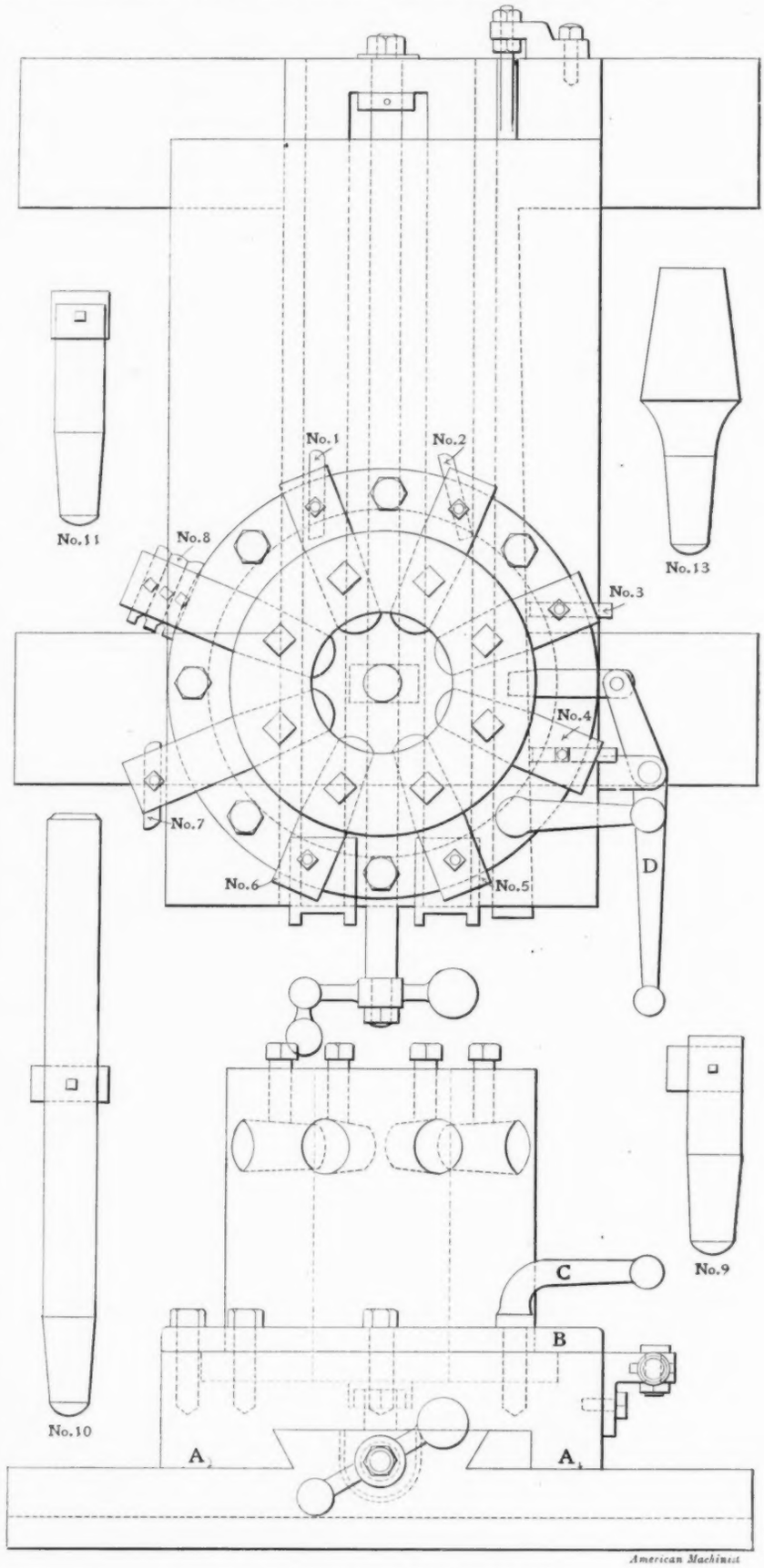


FIG. 1. A TURRET PLACED ON AN OLD LATHE.

After mounting in the turret tools Nos. 10, 1, 11, 13 and another the same as No. 10 but with a finishing cutter in it, chucking arbor No. 13 is first brought around in line with the lathe spindle and the eccentric is placed on it, with the hub down of the faces was done on an emery disk by placing the piece on the table of the grinder. This made a good surface and one perfectly at right angles with the casting. The chucking arbor for the eccentric straps was made with three arms

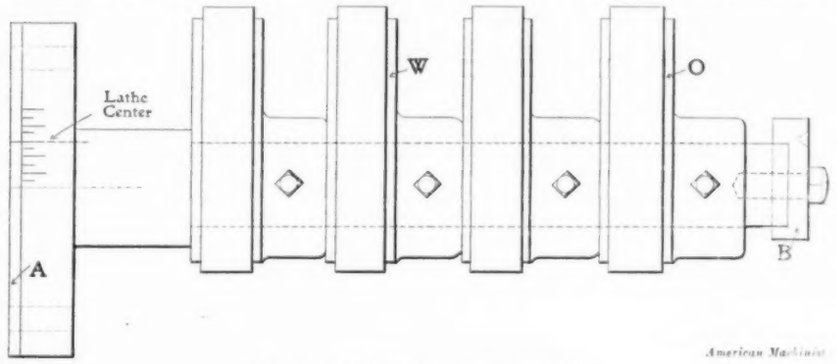


FIG. 2. ECCENTRICS TO BE TURNED.

toward the turret. The carriage is brought forward until the piece is within and back against the jaws of the chuck, and they are then set firmly against the piece to hold it. By using the chucking arbor the piece can be set properly in a very short

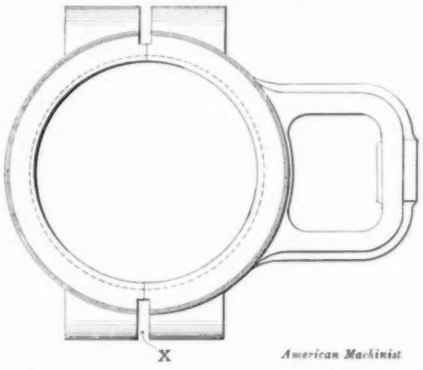


FIG. 3. ECCENTRIC STRAP TO BE TURNED.

time, and with the boring and facing tools the work can be done just as rapidly as with a modern turret lathe.

The eccentric strap, Fig. 3, was cast in one piece, with cored slots *x x* which nearly cut the strap in halves. While in this condition the bolt holes were drilled, after which they were broken apart and the faces dressed even with the flat cored surface, a wooden shim was put in and the bolts were put in place. The dressing

which were adjustable for the various sizes, the piece being chucked in the three-jaw chuck in the same way as the eccentric.

Tool No. 7, as shown in the turret, did the rough cut. No. 8 roughed out the recess, and 9 finished it. Fig. 2 shows four eccentrics mounted on an arbor ready for turning. This arbor was bolted to the face-plate with the tongue in a cross slot. By the use of the scale shown, it could readily be located to suit the throw of the eccentric and the sliding center *B* on the other end was adjusted to the lathe center. Roughing tool No. 1 commences its work at *W* and No. 2 at *O*. Thus it required but 4 inches of travel to rough four pieces. The same was the case with cutters 3 and 4. Cutters 5 and 6 cut out the corners at each side of the eccentric and scraped all to a finish.

In operating this lathe we found it possible to increase the speed of the cone about threefold. We retained the rack and pinion for operating the carriage by hand. The feed nut was made of bronze and was a half nut operated in and out by a lever. The cost of the alterations to this lathe was very small compared with the cost of a modern turret, and for the work within its range it served all the purposes of an expensive tool.

B. W. T.

Laying out a Triplex Crank.

Editor American Machinist:

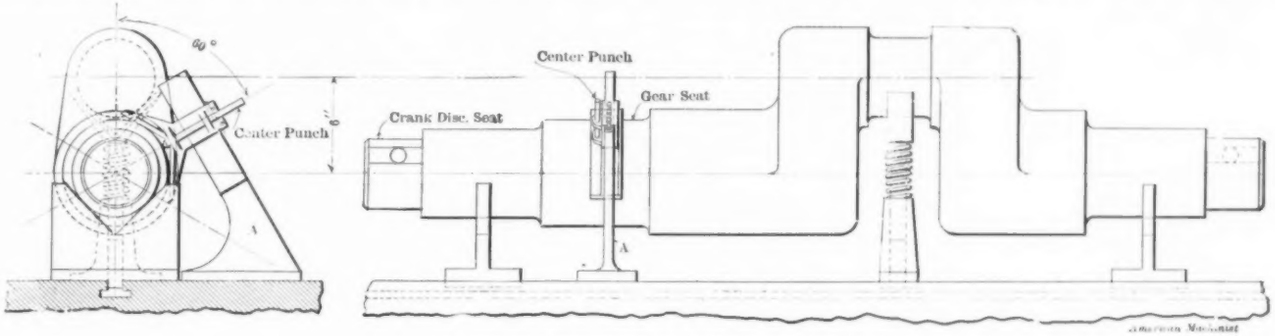
The sketch shows a handy fixture designed by me some time ago for laying out the keyways on triplex crank shafts. The shaft as shown consists of a cast-steel middle crank and shaft, that is to be fitted with crank disks at each end, these disks to be a press fit and the crank pins to be 120 degrees apart.

The shaft rests on V-blocks provided with a tongue planed to fit a planer platen; the tongue central with the "V's". The "V" shown under the middle crank pin also has a tongue planed in the foot to fit the platen. This "V" is pressed upward by a spiral spring and locates the middle crank pin directly over the center line of the shaft. The standard *A* has a sliding head and "V" combined, and a hole also is drilled to accommodate a center punch, both of these at an angle of 60 degrees from the vertical. A light rap with a hammer on the end of the center punch will locate the center of the keyway on the gear seat. From this center scribe a circle indicating the width of the keyway, and lines drawn tangent to this and parallel with the shaft will be the keyway desired. This standard *A* can be moved from one part of the crank shaft to another as the keyways are called for. The keyway in the disks is opposite the pin hole, this being the right location to bring the crank pins 120 degrees apart. C. W. PUTNAM.

The Apprentice and His Tools.

Editor American Machinist:

Now I have the glue on these boards and am ready to drive some brads in and can't find my hammer. "John, have you got my hammer? I do wish you would try and get some tools of your own; I don't mind lending mine, but it is such a nuisance and inconvenience to me and takes up a lot of my time. You first started by asking my permission to take them, now you say nothing but come and help yourself; you take them and never think of returning them unless I ask for them, and when I do get them they are in bad order; you borrow my planes, wood bits, chisels, oilstone, and even my pencil. Can't you scrape up a pencil some place? What are you doing with my inch chisel? You have one of your own, why don't



LAYING OUT KEYSEATS ON TRIPLE CRANKS.

you use that?" "I tried to use it, Mr. Martin, but it is too dull and I knew yours would be sharp." "John, if you want to learn the trade you must learn to keep your tools in order. You can't do work without tools and you can't do it with dull tools. If you are going to learn this trade you'd better start in at once and buy some. Get a few at a time, what you need most, and be sure and get nothing but the best.

"Didn't you tell me you took a piece of calico to a hop last Saturday night and it cost you three bucks? If you had put those three dollars in tools, don't you think they would do more good and leave you something to show for it? Some fine morning you will wake up and find you are obliged to look for work in another shop; then you will wish you had given more of your attention to your trade and tools, and not so much of your time to *calico* and money for *hops*.

"Journeymen are not obliged to, and do not care to, lend tools to any person, and less so to apprentices because they do not understand how to take proper care of them. When I was an apprentice, I took great pleasure in new tools when I knew they were my own, and they gave me a kind of ambition to care and work with them. Try and keep yourself and your bench tidy. You have had that old, dirty, torn apron on until it can stand up alone. A clean apron don't cost much, and your bench looks like a pawnshop window. When you lay anything on it you have to get a search warrant to find it; learn to be neat. Don't forget what I said about saving your money and getting a few tools." MR. MARTIN.

Fixture for Milling Slots in Small Shafts.

Editor American Machinist:

Fig. 1 shows a small shaft used in the construction of special machinery, and Fig. 2 a milling fixture we designed and built for cutting the slots shown in the hollow end. As these shafts are made on

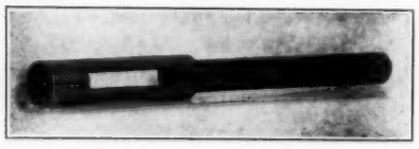


FIG. 1. THE FINISHED SHAFT.

the interchangeable plan, it is absolutely necessary that the first slot should be milled exactly central with the sides and that the work then should be held in such a manner that the second cut will be directly opposite and correspond in length. The stops for determining the travel of the milling machine table are set at each side of the carriage, after the first cut, in order to mill all subsequent pieces to uniform length. The ends of the slot in the work, as shown in Fig. 1, are finished by filing to the extreme length of the cut made by the milling cutter.

The tool is simple, practical and inexpensive, as well as convenient and easy of manipulation, and the principle may be employed for cutting keyways in short shafts, and similar work to receive the Woodruff keys, the fixture of course being

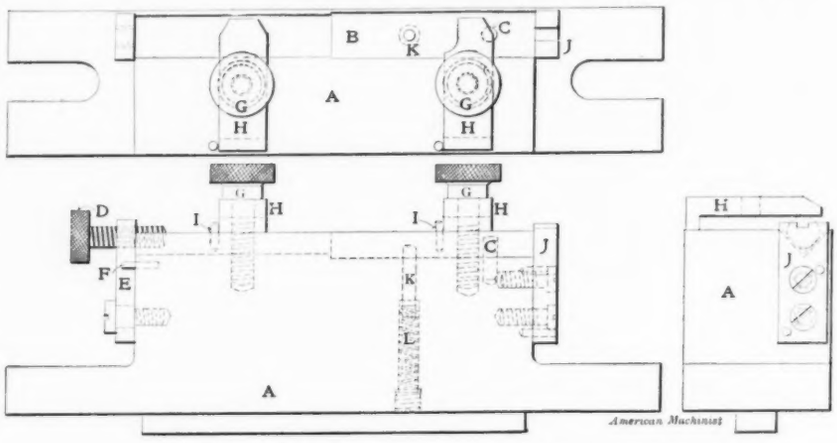


FIG. 2. FIXTURE FOR MILLING SLOTS IN SMALL SHAFT.

modified to adapt it to the size and length of the work and the face of the cutter. *A* is the cast-iron body tongued and slotted at the ends for bolting to the table of the milling machine. *B* is a V-groove with one part planed 1-16 inch below the other to conveniently receive the two diameters of the shaft, ⅜ and ½ inch respectively. The groove is planed near the inside edge—to facilitate the reaching of the work by the slotting cutter—and parallel with the tongue on the under side. The work is placed in the groove and is held against stop-pin *C* by the screw *D* carried in the swinging bracket *E*. This bracket is made purposely to swing clear of the end of the groove to permit the chips to be freely removed when cleaning the jig. To check its backward movement and bring the screw in line to engage the work, pin *F* is provided.

Two special knurled-head shoulder screws *G G* and clamps *H H* are located on top to hold the work in the fixture, and the guide pins *I I* prevent the clamps swinging beyond the desired limit when tightening them down. *J* is a hardened tool-steel gage—fastened to *A* by two ¼-inch screws and ⅛-inch dowels—to set the cutter by in order that no mistake may be made, as it is obvious in this case that an error, no matter how slight, in locating the cutter would result in imperfect work. Practically central, like the set gage, is the pin *K* supported by the helical spring *L*. When the shaft is secured in the V-groove for the first cut, the pin is pressed down beneath it. In the second cut the clamps are loosened a trifle and the work rotated one-half turn, or until the pin springs up and enters the slot already made. The work being clamped in this position, the second cut is made directly opposite the first. C. H. ROWE.

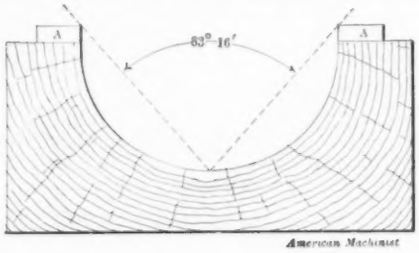
Planing Taper Core Boxes.

Editor American Machinist:

I had a taper core box to make, of wood, the other day, and after putting it in the hands of the patternmaker I watched his preparations with interest, which increased when he reached the planing stage, and, as his plane and method were both new to me, and may be to others, I will describe them, so that those who are unfamiliar with the scheme may profit by his example.

His plane is made with an angle of 83° 16′, instead of the regular 90° of a right angle, and in practice he lays out the semi-circle of the core box and the ends, and fastens upon it, with brads, strips of hardwood having straight edges upon the inside and touching the points where the ends of the semi-circle cut the edges of the blank. The thickness of these strips must be one-sixteenth of an inch or fractional parts thereof for each inch in diameter the core box is to be.

By this method he secures a finished core box, with good sharp edges, which



PLANING TAPER CORE BOXES.

result is accurately obtained without the use of templets or other instruments. All the wear of the plane comes upon the hardwood strips, which save the edges of the core box from becoming rounded, and it is especially of value in generating the surfaces of taper core boxes, in which case he makes his hardwood strips the same taper in sixteenths which he wishes the core box to vary by in inches of its diameter.

It is evident that any fractional basis may be assumed which is most convenient

for the work generally handled, so that instead of adding guide strips of a thickness in sixteenths equal to the diameter in inches, they may be assumed of a thickness in tenths equal to the diameter in inches, and this would put the calculations in decimals. Of course the angle of the plane for such a fractional basis would have to be calculated, and, as the value of the fractional basis was increased the angle would decrease.

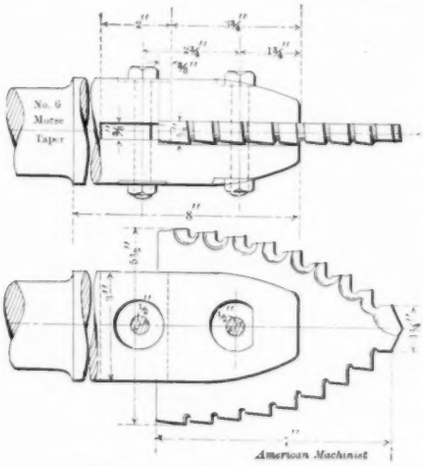
The sketch accompanying gives an illustration of the adaptation of this old proposition, in which *A A* are the strips of hardwood and the angle of the plane sides is shown by the dotted lines.

LUCIEN I. YEOMANS.

A Cutter for Boring a Large Hole.

Editor American Machinist:

We recently had a large number of 5½-inch holes to bore through 1¼-inch tough steel plates and we decided to bore four at a time on our large horizontal boring mill on account of its having a good stiff bar. The plates were bolted together



CUTTER FOR BORING A LARGE HOLE.

against the knee plate on the table. When we started the job we ran a 2-inch drill through and then gradually enlarged the hole by running through cutter after cutter until the required size was reached.

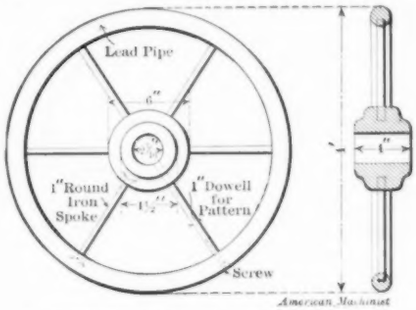
Thinking we could save the time lost in changing cutters, we made this "all-in-one flat fish-tailed cutter" similar to the ones used in boring projectiles. This was run through after we had drilled a hole the diameter of the smallest step. The steps are so proportioned that a uniform amount of metal is removed by each diameter, the width of the cut gradually decreasing as the diameter increases.

The cutter worked to good advantage, saved time, wore well, and cost but little to make and maintain. W. E. BILGER.

A Quickly made Flywheel Pattern.

Editor American Machinist:

I was asked to make a wheel of about the design and dimensions, as shown in sketch. The man wanting the wheel did not wish to expend much money on the pattern, as it was only for an experiment and might not be used again. For the rim I used lead pipe, which I filled with sand and bent around an old boiler shell; the spokes I made of 1-inch dowel pins, laying



A QUICKLY MADE FLYWHEEL PATTERN.

in the mold pieces of 1-inch wrought iron in their places, and the hub I sawed out on a band-saw. For a cheap job it worked quite well. RUSH.

"To Fit"—Making Lead Laps.

Editor American Machinist:

I was quite interested in the article "To Fit," by John Randol, at page 800, but I fear that the words "To Fit" on a drawing along with other instructions will not always obviate the possibility of making a mistake, although they may serve as another nail in the machinist's coffin by throwing the blame on him for a mistake. If there is a possible chance of making a mistake it is sure to be found in a machine shop. I have a case in mind which seems nearly equivalent to what Mr. Randol's would have been with the "To Fit" on the drawing, and yet a good man did a job wrong and could not be convinced to the point of admitting that the mistake was his. The job was a jig with the distance between two holes given on the drawing as "0.974 inch same as jig No. 71." The workman put the holes into his jig 0.974 inch apart exactly, or as near as we could measure, without making any attempt to ascertain whether the corresponding holes in No. 71 were that distance apart, as they were supposed to be. As a matter of fact, they were 0.003 or 0.004 inch farther apart, and this made it necessary to re-bore the new jig. The toolmaker was indignant when told that he should have gone to the toolroom and found for himself the actual condition of the other jig before boring his holes.

I think the workman should have looked into the meaning of this note first, as it was unusual in our shop, the distances between bushing holes being put on drawings ordinarily in decimals without additional note, and the presence of this note would therefore imply the need of a little investigation on his part. This measurement must have been on the drawing of the other jig as 0.974 inch, but the one who made that jig might not have succeeded in getting it just that, or someone might have measured it without being careful to get the actual distance. At any rate, the drawing of the second jig made it plain that so far as those two holes were concerned they should be the same distance apart as those in the other jig and the toolmaker should have seen that they were before he turned in the work completed.

I was also interested in the laps described by H. A., at page 804, and by Wheeler, at page 808. It seems to me that Wheeler's method is all right, and I think that a man could do more lapping in a day with a lead lap handled as Wheeler

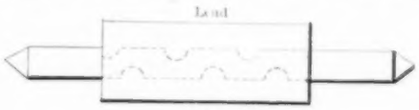


FIG. 1

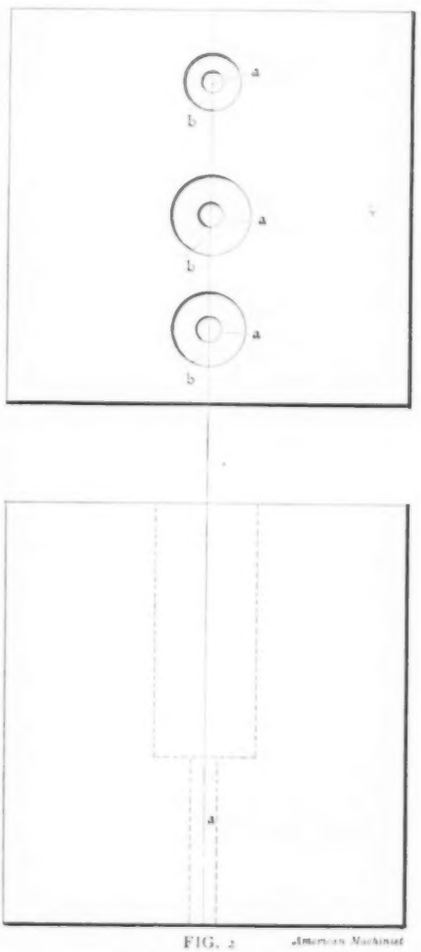


FIG. 2

MOLD FOR LEAD LAP.

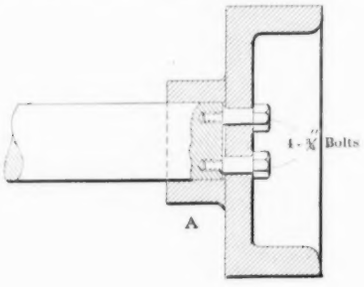
handles it than in two or three days with a piece of soft steel split, for the reason that steel will not charge or become imbedded with emery as lead will. I have a lead lap 0.078 inch in diameter with which I have opened fifteen bushings 0.0015 inch and apparently it is in condition to do as many more. This lap was made on a piece of No. 53 wire about 1½ inches long with the lead poured 1 inch long, as per sketch, the lead being poured considerably larger to allow for turning

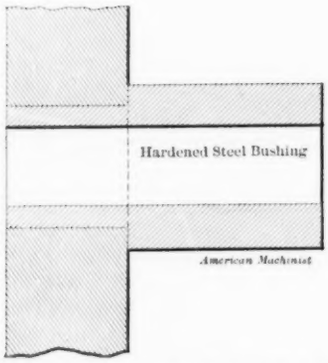
to size. In turning down, one end of the wire is held in an Almond chuck in the lathe spindle and the other end runs in a small female center held in another chuck in the tailstock spindle. With the wooden blocks shown in Fig. 2 and a small melting ladle we are rigged for making all sizes of laps under ¼ inch. The hole at *a* must be just the diameter of the wire on which the lap is made, the hole at *b* being the size of the lap before it is turned. Now, when a small lap is wanted if three or four wires are notched, as shown at Fig. 1, to hold the lead, and several laps are poured so that for the next few of nearly the same size it will not be necessary to stop to melt lead, the expedition with which the work can be done will surprise those who have not been familiar with the method and one who has gotten acquainted with lead lapping will not care to return to split steel rods. For work which is too small for a lead lap I find copper wire answers pretty well, as it holds emery better than brass. N. A. C.

Fastening a Coupling to an Engine Shaft.

Editor American Machinist:

My friend Tim tells me of a smart trick of his that may interest your readers. He was "up against it" once upon a time as follows: He had an engine shaft 8 inches in diameter in a very cramped position. He wished to put a coupling on it like sketch *A*. The coupling was to be fastened with body-bound ¾-inch bolts, and must





FASTENING A COUPLING TO AN ENGINE SHAFT.

be put on in the short intervals that the engine was idle. Owing to its cramped position he could only get a quarter turn on the ratchet. The problem was then to ratchet drill and tap the four holes exactly true to the coupling

He made the bolts with a 1-inch body and ½-inch threaded end. Then he made two bushes and hardened them so they could not be cut. He put his coupling on, put in his drill bush and drilled the first hole, put in his tap bush and tapped the first hole and put in his first bolt. Then he did the same with the other three, and had a good job. F. W. Harris.

Piston Rings for Gas Engines.

Editor American Machinist:

We would like to know whether the pistons, or more especially the cylinders, of gas engines are made quite cylindrical, or if they are slightly conical on account of the dilatation due to the high temperature at the rear end, so that they will be cylindrical when they are hot? We have gone through the experience, related at page 617 of the 1901 volume, of the Willans & Robinson works, and we have done the same with our piston rings, securing a perfect result. Our way of making piston rings may perhaps interest your readers.

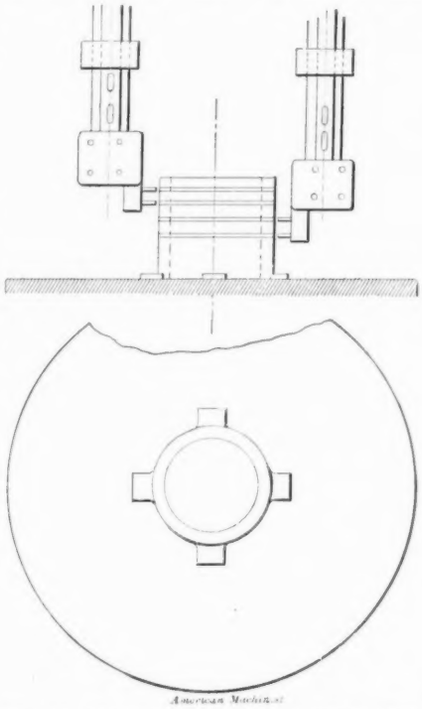


FIG. 1. ROUGHING OUT AND CUTTING OFF THE RINGS.

We turn a casting, Fig. 1, from which we cut a number of rings at a diameter slightly greater than that of the cylinder; then we face them on both sides to the exact width, Fig. 2, and we cut them, removing a certain length. We put them five at once on the lathe, fastening them to a face-plate, Fig. 3, after having sprung them in by a sheet-iron band around them. When they are securely strapped, we turn the exterior to the bore of the cylinder. When this is done, we put on the sheet-iron band again, loosen them from the lathe and slide them into a casting, Fig. 4, on another lathe and having the diameter of the cylinder, when we rebore the inside. You must know that our piston rings have always the same thickness, whatever may be the diameter of the cylinder; only their width changes with the diameter, so as to

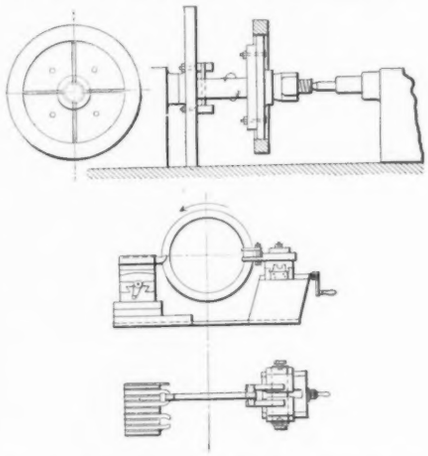


FIG. 2. FINISHING THE SIDES OF THE RINGS ON AN EXPANDING MANDREL.

always have same rigidity per square centimeter of surface. A. Bollinckx.

Brussels, Belgium.

A Jig for Drilling a Small Eccentric.

Editor American Machinist:

The sketch shows two views of a jig in which the indexing dial principle is utilized for the rapid drilling of a small eccentric. This jig is so constructed as to allow the work, when finished, to be self-releasing. It consists of a body casting *A*, planed and finished on all sides, and having the legs *B B* scraped. It is bored to admit the stem *D* of the index and receiver plate *C* which has eight holes *F*, bored and finished to allow the work to fit nicely within them. The four holes *L* are the index or spacing points, and are

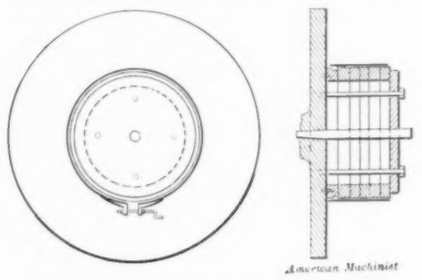


FIG. 3. FINISHING OUTSIDES OF RINGS.

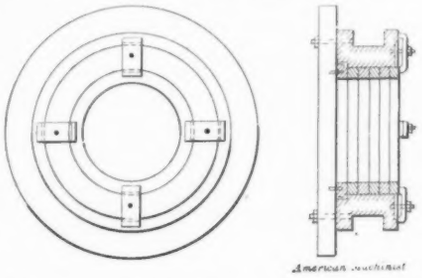
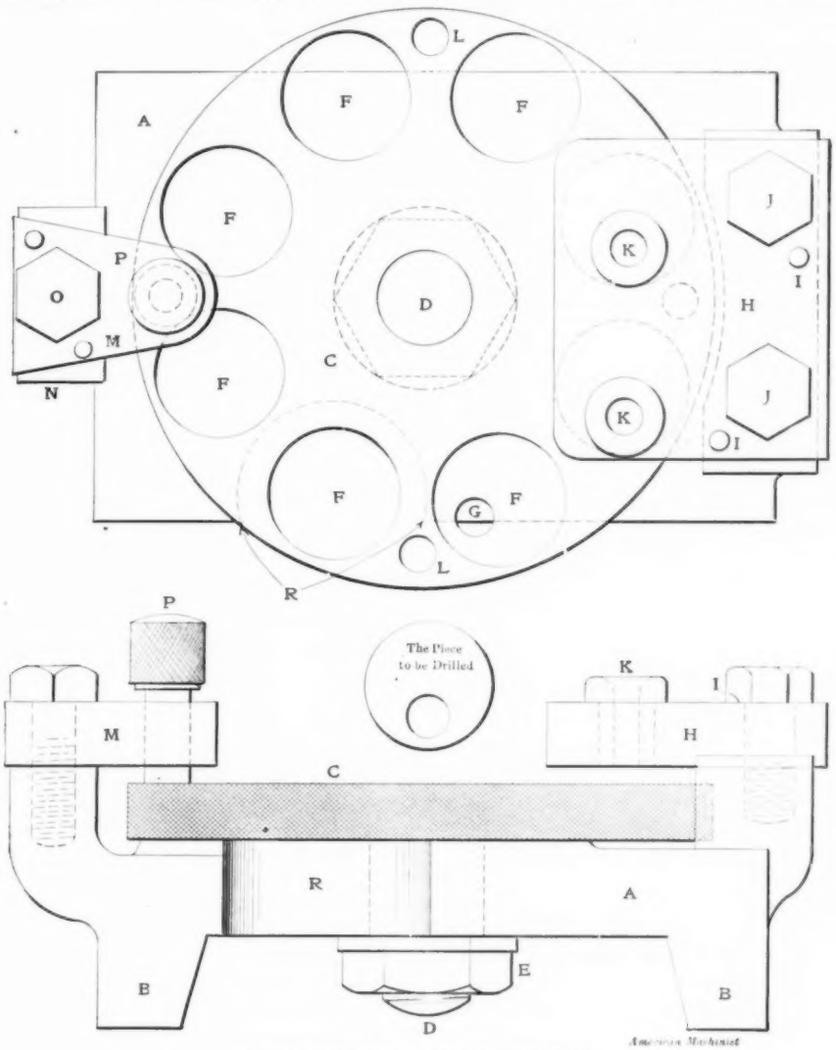


FIG. 4. FINISHING THE INSIDES OF THE RINGS.

all reamed to exactly the same size. The bushing plate *H* is fastened by the dowel-pins *I I* and the two cap-screws *J J*. This is done before locating and finishing the bushing holes. The bushings *K K* are let into the plate *H*, as shown, and are ground and lapped to size. Care is necessary in locating and finishing the bushing holes to get them in the exact position required, as the hole in the work must be off center a given distance. The index pin *P* fits snugly in the hole in the plate *M* and the holes *L* in the index or receiving plate. The spacing and locating of all holes for the bushings, index pin and receiver for the work are accomplished by the button method on the dividing head of the universal milling machine. The receiver holes *F* are all finished to size with a special reamer.



JIG FOR DRILLING A SMALL ECCENTRIC.

When in operation, one of the pieces to be drilled is placed in each of the eight holes *F*. The dial is then turned until the first two pieces are under the bushings *K K*, when the index pin *P* is entered in the hole *L*, and the two pieces are drilled. The index pin is now removed, the dial turned one space and the index pin re-entered. This brings the next two pieces under the bushings. The first piece drilled drops through the jig at *R*, the bottom of the jig being cut away at this point as shown by the dotted lines. The second piece drilled remains at *G*. Now the dial is moved around and pieces put in the holes as the finished work drops out. As will be readily seen, the design of this jig allows of the continuous drilling of the work, without loss of time in the removal of same when finished. Moreover, the placing of the work in the holes in the dial can be accomplished very rapidly, and this is one of the best features of the jig, as the saving of time in this operation is quite important. This jig can be used to advantage for the drilling of holes in small parts which have been previously machined to a uniform size. For the drilling of work in which great accuracy is desired, the indexing or spacing holes in the dial should be equipped with hardened steel bushings, lapped to a size allowing of a snug fit for the index pin.

PETER CHIAMPON.

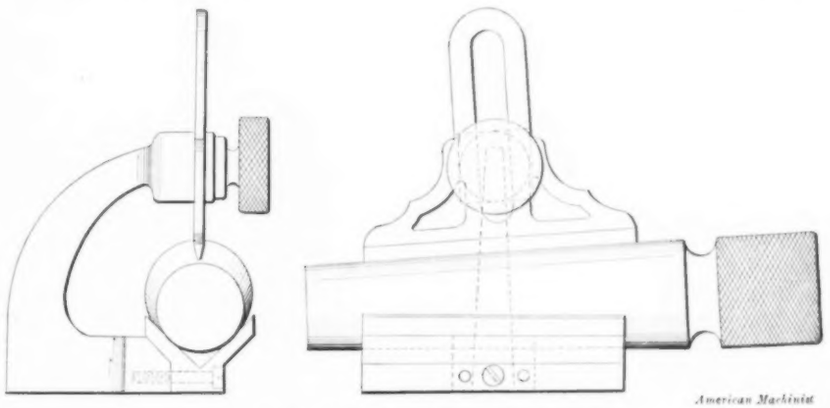
A Taper Gage.

Editor American Machinist:

The taper gage shown is handy within its range for reproducing lathe centers, collets, arbors and other tapered work of which duplicate pieces are required. By the use of this gage the cut-and-try method of fitting to a taper hole, as is the usual practice when running lathe centers, can be dispensed with to advantage, since with it the tapers can be duplicated without stoppage of the machine for which they are intended, and in less time, because the slightest error can be seen by holding to the light, while by the common method it is a question of feeling, which consequently admits more possibility of error.

I have used the gage for eight years and have never seen one more practical. I do not know the originator of it, but feel under obligation for its great service, and I trust that it may be of interest to others.

Philadelphia. W. B. MEHL.



A TAPER GAGE FOR LATHE CENTERS, ETC.

Home Made Scales.

Editor American Machinist:

The art of accurately graduating bars of steel for measuring purposes is one that is little known outside a few fine-tool shops and by but few men in those shops. It is a great mystery to everyone who has not been on the inside, and one wonders just what the graduating machines look like.

No one objects to paying the very reasonable price now asked per inch for the accurate hardened scales we are buying.

and most every machinist has two or more of the handy lengths in his kit.

It is in the toolroom that one generally finds scales from three to eight feet in length, and occasionally longer. Scales of considerable length increase in price per inch as the stock is of much larger cross-section.

Besides in the tool-room, scales and measuring rods are needed by the blacksmith, boilermaker, erector and others, and as less accurate measures will generally answer their purposes it is vastly cheaper to make than to buy them, when one has a good standard to serve as a master gage.

Nearly every lad, after he has been at the trade a short while, thinks he will make, among other things, a scale. I judge most of us have been there, and know that the work requires a good deal of patience.

With the device here shown it is quite possible to make a very good scale for general shop use. The measures can be made of any size; those of from four to eight feet in length of 1x¼ inch, those from eight to twelve feet of 1¼x¼-inch bar steel. The most convenient scale is made with a short hook at one end. From the hook usually two or more feet are left blank, depending on the length and the use to which the scale is to be put.

Our first graduating was done by laying the bar to be marked and our B. & S. standard side by side, squaring across and using a scriber, then deepening the scratches with a small chisel. This method was unsatisfactory because the cuts were uneven, and the scales were stretched. The objections were partly overcome by making the markers as shown in Fig. 1. There were four of these of different widths for the different lengths of lines. A still further improvement was made by using the device shown in Fig. 2, which does away with the use of the scriber.

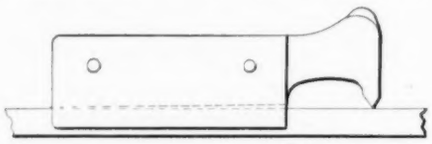


FIG. 1

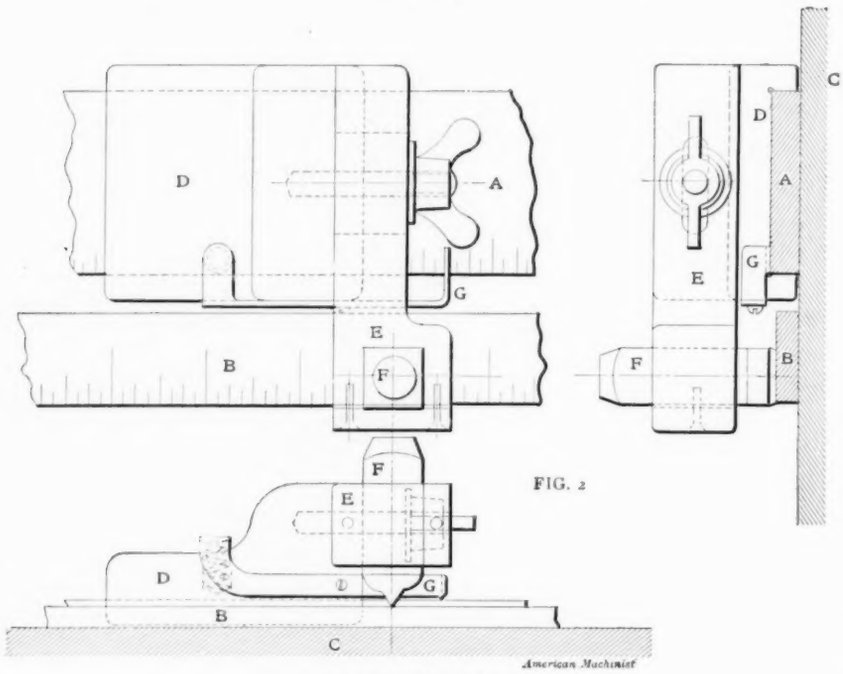


FIG. 2

GRADUATING A SCALE.

The standard scale *A* and the bar *B* to be marked are clamped, as shown, on a suitable anvil *C*, say a bar of 4x2-inch iron 5 feet long, planed smooth. The body of the tool *D* fits over *A* freely but without play. The bar *E*, carrying the marker, is arranged to move in and out on the bearing at the right of *D*, and is thus adjustable for the four lengths of lines. The small finger *G* is held against the standard scale by a small spiral spring, and acts as a finder to locate the device; the knife edge dropping into the lines on the standard. When located correctly, a light blow with a medium-size hammer on the head of *F* will make a true, clear line.

About two feet are done at a time, all lines being marked the length of the one-eighth graduation, then quarters are lengthened, then the halves, and lastly the inch lines.

Should any stretch occur, which is likely if the material is of small section, a reset after the two feet are marked will be necessary, and should the bar be bowed it must be straightened.

In operation the device is not slow and the results are all that could be desired, both for nearness to standard and neatness in appearance.

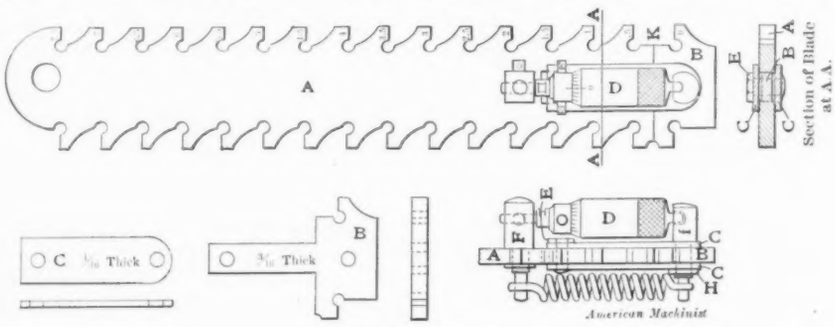
The scales we have made have been within one one-hundredth of an inch of standard in ten feet, are clean cut, and altogether satisfactory. H. E. B.

A Micrometer Gage.

Editor American Machinist:

I send you a sketch of a micrometer gage, designed for setting calipers where sizes a little bit more or less than standard are wanted, which I think will interest some of your readers.

Referring to the sketch, *A* is a blade having on each side a series of steps ½ inch apart, those on one side being for inside measurements and the others for outside measurements. The gage shown is for measurements from ½ to 7½ inches by thousandths, but the blade, of course, can be made any desired length. The blade is slotted to receive the sliding head *B*, which is held in place by two plates *C*, as shown. A post *f* passes through the plates and head, nut *H* clamping the three members together. The clamp screw *E* also passes through the two plates and the tongue of sliding head *B*. The post *F* is fixed to blade *A* and the spring connecting posts *F* and *f* acts to hold the sliding head against the end of the blade. *D* is a standard 2-inch inside micrometer set in between the two posts, the extension rod passing through post *F* and clamped by screw *I* and the other end working free in post *f*, as shown. To put the micrometer in place, first set it at zero, with the extension rod out far enough to pass through post *F* and clamped firmly with the set-screw in the micrometer, then press



MICROMETER GAGE.

on the end of the extension rod, forcing the micrometer towards post *f* and tighten the clamping screw *I*, being careful to hold the sliding head against the blade.

Opening the micrometer causes the sliding head *B* to move away from the blade, thus the reading of the gage will be the sum of the ½-inch steps plus the reading of the micrometer.

At first glance it would appear that this would be an expensive tool to make, but such is not the case. Any shop having a cutter grinder can make the gage sufficiently accurate to meet all requirements, the only difficult operations being hardening and grinding.

In hardening, the whole blade should *not* be hardened at once. Use a bath of soft water in a vessel deep enough to receive the blade lengthwise and cover this with a sheet of asbestos about ⅛ inch thick, a slot just large enough to permit the blade to pass through being cut in the asbestos. Suspend the gage over the bath by means of a wire or string running over a pulley overhead, and to the other end of the wire attach a counterweight to support the blade. When these preparations are completed, take a blowpipe with gas or alcohol flame and with the step to be hardened just above the asbestos cover of the bath direct a small jet of flame on the extreme point of the step. When the desired heat is secured, push the blade quickly down into the bath. Repeat this operation on each step, first on one set of steps and then on the other. When all the steps are hardened, polish the blade and suspend as before. Heat a soldering iron —one with a flat, square point preferred— and, applying this to one side of the step, draw the temper to a dark straw and immerse as in the previous operation. This method leaves a soft center, reducing the liability of breaking, and there is also little or no distortion due to hardening. Before grinding allow the blade to season thoroughly.

The sliding head *B* can be hardened all over. In fitting this head in the blade extreme care should be taken to have no lost motion sideways. The tongue should be slightly thinner than the blade (say, 0.001 inch), so that plates *C* will bear on the blade and the sliding tension will be regulated by nut *H* and stud *E*. Also, when the head is in the blade as far as it will go, see that a good joint is made at *K* and that finish is left on the faces of the steps; that is, the distance between the step on the movable jaw and the first step on the female side of the blade should be less than ½ inch, and the distance across the movable step and first step on the male side more than ½ inch. Assuming that in milling the steps no greater variation than 0.005 inch occurred, 0.008 inch should be enough for grinding. When ready to grind, see that the sliding head *B* is securely fastened against the end of the blade and then clamp to a parallel strip with steps projecting far enough to permit free passage of the grinding wheel. A dished or crescent-shaped wheel should be used. Grind the zero step first, taking only enough off the step on the sliding head to square it up, and taking the balance off the step on the blade. For a master gage to grind the step to, use any caliper square, setting it to a standard gage and measuring in each case from the step on the sliding head to the steps being ground.

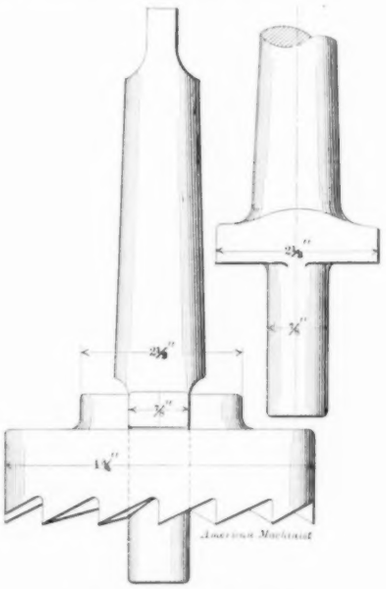
The uses to which this gage can be put are numerous; one is in making a press fit. Say that the hole is made and the allowance for pressing is to be 0.0035 inch. The hole is carefully calipered and found to be slightly over 6 inches. Taking the micrometer gage, it is found that the calipers will not go between 0 and 6 on the female side. The sliding head *B* is then opened by turning the micrometer until the calipers fit the gage. By reference to the graduations on the micrometer it is found that it reads, say, 0.0045, and this, added to 6 inches, gives us a size which is 6.0045 inches. Now, as an allowance of 0.0035 inch is desired for pressing, the micrometer is backed off 0.0035 inch and the outside calipers then set to the 6-inch step on the male side of the gage.

H. E. T.

A Special Drive for a Facing Cutter.

Editor American Machinist:

In boiler work and other places it is sometimes necessary to face off a surface of considerable diameter about a small hole on which to make a joint for a valve or



DRIVE FOR A FACING CUTTER.

other fitting, and the job may have to be done with a ratchet or air machine.

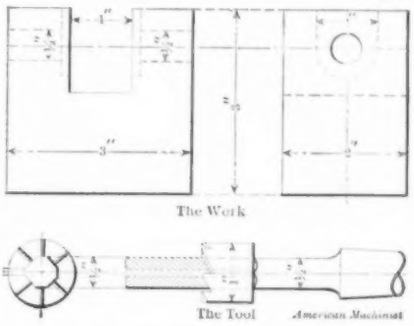
The sketch shows a cutter and its shank as used for this purpose, and attention is called to the manner of driving. The shank being too small to carry a key to drive so large a cutter, this method, although not new, has been used to advantage. The lugs on each side of the shank fit into the groove, cut across the boss on the back of the cutter.

H. E. B.

A Square Drive.

Editor American Machinist:

Recently we had a little job for which we had first to make the tools. The work was a lot of blocks of common steel,



AN INSIDE COUNTERBORING JOB.

3x3x2 inches, cut out as shown. Through both lugs a ½-inch hole was to be drilled, and on the inside of each jaw the holes were to be counterbored ¼ inch deep and 1 inch diameter. Then the counterbored places were to be cut straight through to the outer edge, as shown by the dotted lines.

The special tool we had to make was to do the counterboring, and the job was to be done on a small drill press. The bar being only ½ inch diameter, e considered it too light to hold a key or set-screw to drive the face cutter, and so we adopted the method indicated in the sketch. The end of the bar was squared part way, leaving the corners with 3-32 inch bearing, and making the hole in the cutter a free fit. The shoulders formed where the squared portion ended were sufficient to hold the cutter in place and to take the pressure when fed into the work.

First one side was done; then the bar and cutter were taken out, the piece was reversed and the other side was done in the same way.

A square drive, though costing more to make, is very often better than a key or a set-screw in a short, small job.

This may be new to the younger boys; the old fellows knew it long ago.

H. E. B.

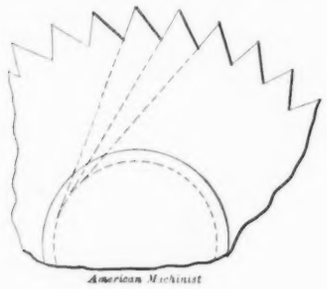
Sawing Copper.

Editor American Machinist:

It is well known that there are difficulties in the way of sawing copper, although some people who sell saws will advertise them as suitable for steel, brass, copper, etc., as though there were no difference.

Whenever a cutting tool which will satisfactorily cut one material fails to cut another material, the cause must be sought in the properties of the material to be cut. It is not of much good trying different sorts of lubricants. Indeed, I have reason

to believe that a lubricant may enable a saw to fail that has proved capable of cutting dry. When saws fail to cut copper they appear to strip whole teeth and to break right across, or large pieces come out of the saw disk. Some time ago I came across the difficulty, and when I came to study the question I came to the



SAW FOR COPPER.

conclusion that the reason for failure was all on account of the peculiar nature of the copper. It is a very tough metal to begin with, and is well known for the difficulty in turning it, which is effected at a high speed with a fine-pointed tool. In taking a cut from a copper surface, the shaving does not readily break, but it pulls up more copper, tearing this out in irregular little lumps from the surface behind the chip. The chip fails to get away. It travels down the face of the tooth, fills the whole tooth space and finally forms so powerful an obstruction to progress as to break a tooth, or, by the combined action of several teeth, to break the saw. In each case I found on examination that the teeth were radial on their advancing faces, and I concluded that this gave the sharp point every chance of tearing up the floor of the cut, the saw teeth endeavoring to draw themselves into the metal.

The sketch shows how the teeth ought to be made. The face of the tooth is not a radial line, but slopes forward at the base at such an angle as to touch a circle of about 7/8 inch diameter. After coming to this discovery, I went to see some copper bars being cut at a place where I had known the work was being done successfully, but not having experienced this copper trouble I had not had the sense to examine the kind of saws employed when I had had previous opportunities. I found that they were using just such saws as I had concluded should be used. They ran at ordinary speeds and fed quickly and experienced no trouble.

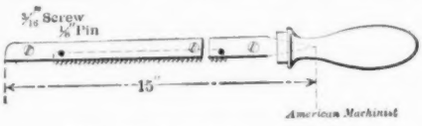
If this slope-fronted tooth be considered, it will be perceived that its action is to push the copper away from the saw if possible, but, as there is a feed on, something has to give way and the copper is removed in small chips which do not now tear up the floor of the cut. The sloping form of tooth strokes down the copper and only the desired cut is removed. In plain words, the saw does not dig in. I have not had the opportunity of trying it, but should have tried the effect of running an ordinary straight-faced saw reverse way round for copper. Quite possibly it might not cut at all, being too much flattened on the tooth back. The happy mean is somewhat as shown, and these saws are sold here for copper cutting, I found out, and had not attracted any special attention when I found them at work, perhaps because there may have been no steel sawing done and the copper-sawing history, if ever it had been a difficulty, had been forgotten. It is therefore, in my opinion, altogether a matter of tooth shape and not of lubrication or set, beyond perhaps hollow grinding, though those I saw were in the black.

W. H. Booth.

Tool for Cutting Oil Grooves in Long Boxes.

Editor American Machinist:

In studying your paper, I notice some good ideas of Cincinnati men. Thinking I might have a chance to stand in line with these men, I will send you a sketch of a good device for cutting oil grooves in boxes. The tool is made in four pieces. The two sides are 3/8x3-16 inch cold-rolled,



TOOL FOR CUTTING OIL GROOVES.

15 inches long, and a 12-inch hacksaw blade is placed between. These side strips are held together by 3-16 inch screws, and the blade is held by 1/8-inch pins. A common file handle is driven on one end of the frame, as shown. This tool is used for long boxes.

Joe Spahn, Jr.

Norwood, Ohio.

A Simple Method of Locating Punch-Holders and Dies.

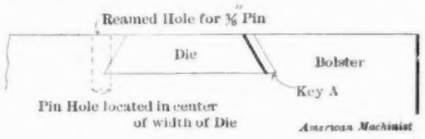
Editor American Machinist:

Having a number of punch presses in charge where it was necessary to change the punches and dies very frequently, and therefore important that this should be done with little or no loss of time, I looked into the matter, and finding that the bolsters in all cases were so designed that they always came in exactly the same position, even though they were removed and replaced, I decided to install this same feature in the dies.

As will be seen by the sketch, the die is simply set in its proper place, being held there by a steel key *A*, which is slightly tapered, and a 3/8-inch hole is then drilled and reamed in such a position that about one-half of it projects into the die.

All that is necessary now is to drive in a piece of 3/8-inch round cold rolled stock, which is left there for good. To remove the die it is only necessary to drive out the key *A* and slide the die to the right or away from the pin and into the space left when the key is removed.

The same principle was applied to the punch-holders, which, by the way, were of steel and and held in large cast-iron holders which came with the presses. The cast-iron holders were also so arranged that they could be removed and put back always in exactly the same position. In conclusion, I would say that by this method the punches and dies were changed by the press hands (unskilled labor). As can readily be seen, we



LOCATING A DIE IN THE BOLSTER.

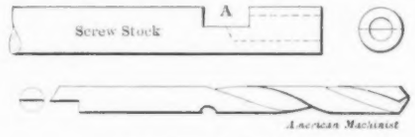
had no trouble on account of misplaced punches and dies, and had besides a cheap way of handling the same.

Harry Ash.

An Extension Drill.

Editor American Machinist:

Oftentimes we want to use a long drill, and to get one "extensionized" we send it down to the blacksmith's shop and get a piece welded on; result, a wabbly drill and maybe a "good enough" job. Here is a drill kink invented or rather inspired by George Woodbury that's a reducer of cuss words and a meritorious addition to our stock of mechanical kinks. Take a piece of round screw stock the required length for the extension and slightly larger than the drill you want to use, and drill a hole 1 inch deep in one end a slip fit for shank of drill to be used.



EXTENSION DRILL.

File a slot about 3/8 inch wide to the center at *A*, and file the end of the shank of drill as in the drawing. Drive the drill in, and you have a neat extension drill.

Carroll Ashley.

Making Small Springs.

Editor American Machinist:

I have had occasion at various times during my experience to use small springs of many different shapes and sizes. It is impossible or impracticable in many instances to buy these goods, and we are therefore confronted with the problem of making them more successfully.

In the first place, use no steel which cannot be relied upon to produce uniformly good results. Use a Bunsen or blowpipe flame for heating, if possible. Cut the untempered stock to size and shape as nearly as may be. Exercise great care to have the work sufficiently hot while bending to avoid all danger of breaking or creating flaws whch will cause breaks later. This can be accomplished only by having all tools (pliers, forms, etc.), which

are used in shaping at a sufficiently high temperature to avoid chilling. I have found this to be the secret of success in this class of work: Be sure to avoid flaws before hardening. After shaping, heat sufficiently and drop into oil or fat to cool. Hardening in oil requires a slightly higher heat than when water is used, but be careful to avoid overheating. Now, to draw the temper, place the hardened spring in a ladle or other vessel, cover with fat or oil and heat until the vapor given off ignites; then discontinue the heating and allow to cool. In some cases the flame may be allowed to burn itself out, although this method will generally produce a somewhat softer temper. I have used nearly all of the animal oils and fats with good results. By using different fats and extinguishing the fat vapor flame earlier or later, the temper may be varied to suit all requirements.

One class of springs of which I made a large number was for the cheaper grade of revolvers. A number of the arms use springs of flat steel bent to a pointed acute angle. In making these, I bent the steel without removing it from the flame. They were made in some instances from old clock and watch springs, and produced excellent results, averaging over 95 per cent. of perfect springs. J. R. PRICE.

West Philadelphia.

An Indexing Milling Fixture.

Editor American Machinist:

This index plate I designed especially for machining the clutch collars used so extensively on power presses, but other work can be clamped on it and worked to advantage, either on a milling machine or planer.

The work is clamped on the round cast-

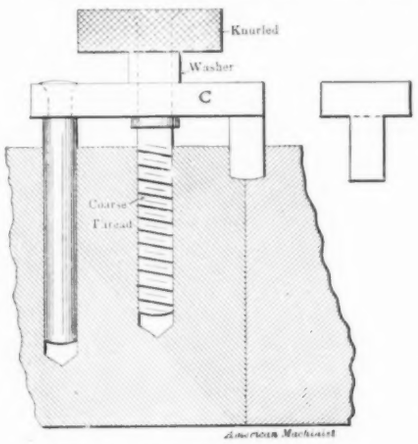


FIG. 2. LOCKING ARRANGEMENT.

iron plate *F*, Fig. 1, by means of clamps with bolts held in the T-slots. The collars are centered by means of a plug *G* that fits in recess *E*. Worm shaft *H* operated with a crank turns the table in either direction. I have indexed the table at three points and index finger *C*, Figs. 1 and 2, assisted by clamp *I*, holds the table firmly in position. The finger may be unscrewed, and work continuously turned and machined at the will of the operator.

CARROLL ASHLEY.

Peculiar Treatment of Steel—Opinions Among Mechanics.

Editor American Machinist:

The other day I took a piece of rail to a blacksmith to have an anvil made of it. I also took him a piece of tool steel for

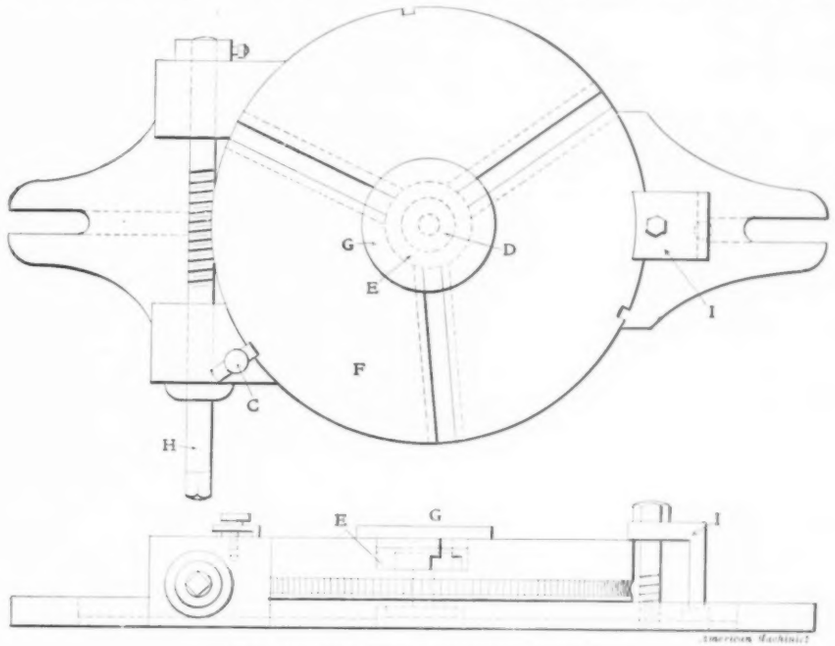


FIG. 1. INDEXING MILLING FIXTURE.

the "hardy," and it was the latter that led me to write. The hardy he made for my little anvil was straight up and down on one side and beveled on the opposite side. I had never seen a hardy built like that, and so I remonstrated; but the old man calmly squelched my protests, with the superior air which can only be attained after thirty or forty years' practice of a trade, by telling me that all hardies were made that way and showing me the one he used as evidence. I might have shown him half a dozen others that were not lop-sided, within ten minutes' walk of his shop; but I refrained, because it would have hurt his feelings, and, besides, he would have declared them all freaks and exceptions to prove the rule.

That reminds me of an old fellow who used to make punches for a perforating concern. One day I had to go to his fire on a little matter of business, and my astonishment was very great when I saw him pull a bar of steel from the fire with stars flying from it in a manner which plainly proclaimed that it was very badly burnt. Knowing his experience and reputation, it startled me to think that he would burn his steel; but he didn't seem to mind it a bit and simply quenched it and stuck it back into the fire, got a good heat on it and hammered it into a punch. After cutting off the punch, he again burnt the steel, quenched it, took a fresh heat and made another punch. I asked him whether he thought the punches would stand. "Of course they will," he said. "But," I objected, "you burnt the steel." "Nonsense," he replied, "that's the way to make punches."

I took special pains to verify the fact that he always went through that extraordinary performance and that his punches were uniformly satisfactory. I fully agree with friend Osborne that burnt steel can't be doctored; yet here was a man making good punches from burnt steel. I suppose the explanation of the matter was that the steel was higher in carbon than was good for punches and that he decarbonized it just enough, in slightly burning it, to bring the carbon to the proper percentage for punch making. At the same time I do not agree with him that that is the proper way to make punches, and I wouldn't advise my friends to try the method. It would be cheaper and better to get the right kind of steel and treat it kindly.

There was once a safe-maker, who was among the pioneers in the use of steel, who made a great talking point of the superiority of steel over iron. In the early days the majority of safe-makers decried steel on account of its brittleness. This fellow, one of the smartest New England Yankees I ever met, would go to a prospective customer and extol the superior virtues of steel. When a customer objected to steel on account of its brittleness and backed up his objection with the name of a rival safe-maker who had told him all about it, my friend would declare that he had fifty dollars in his pocket that he would give the customer if he failed to prove that steel would stand more blows from a sledge than iron. Naturally, the customer would think he had a sure thing

and take him up. Then they would adjourn to the nearest smithshop and our Yankee would open his grip and hand the smith a sample of his rival's iron, which the smith would be directed to lay on a couple of supports and strike a good, sharp blow with his sledge. Usually the sample broke at the first or second blow. Examination of the fracture showed a nice silky fiber, indicating a high grade of wrought iron. Another bar was then produced by Mr. Yankee with the remark that that was his steel and that he wanted the smith to hit it hard. As a rule, this sample would stand thirty to forty blows without breaking, merely bending back and forth. The result of the demonstration usually was that both customer and smith were nonplussed and that the Yankee made the sale. Nowadays we know more about both steel and iron, and the explanation is simple enough. The iron was a cold, short specimen, selected by "Yankee" on account of its brittleness, while the steel was a particularly soft and tenacious piece of open-hearth material. The curious thing about the whole matter is that "Yankee" told his story so often that he finally came to believe it; and when he quit the safe business for another he used steel for a purpose which could have been equally well filled by iron, and actually thought it useless to try to use the latter material "because it would not stand bending."

There is a certain well-known shop in which the junior partner is a business man without technical knowledge. This gentleman once remarked to me that the thing that had struck him most forcibly was the great variety of opinions among the mechanics who bought the product which he sold. He didn't seem able to understand it at all. Now, he had met some mechanics who were as bigoted and self-opinionated as my blacksmith and my safemaker, and he had also met a lot more who were of a thoroughly judicial temperament and who studied and weighed both sides of a question before forming their opinions. Naturally, these two classes could not agree. Again, many of his customers had become accustomed, through years of practice, to certain methods which seemed to them the best because the most familiar; while others had tried and adopted still other methods with highly satisfactory results.

What our friend had failed to notice was that the same differences of opinion exist among those who, like himself, have had a purely commercial training. Scarcely any two firms follow exactly the same business policy. Doctors use widely different treatments for the same disease. Lawyers and judges constantly disagree as to the interpretation and application of laws, and yet some people are foolish enough to expect all mechanics to agree, forgetting that experience, environment and disposition all vary and must necessarily lead to some differences of opinion.

And now the moral to be drawn from all this seems to me to be that it is wise to respect the opinions of others while acting on your own, and not to call the other chap "too theoretical" simply because his ways differ from yours. A receptive mind is an essential to progress, and he who does not progress is surely dropping behind the procession in these hustling times. L. O. DANSE.

A Fixture for the Magnetic Chuck.

Editor American Machinist:

The magnetic chuck has found a place for itself in hundreds of shops for holding simple flat work for grinding, turning and planing operations. The following paragraphs describe a simple and cheap fixture made at the suggestion of our foreman for holding work a little complicated in shape:

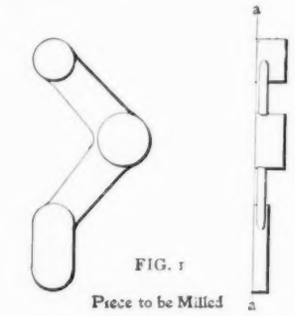
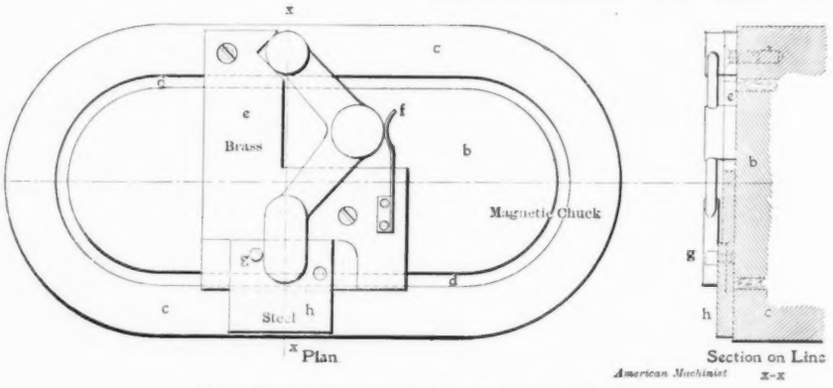


FIG. 1

Piece to be Milled



MILLING FIXTURE USED ON MAGNETIC CHUCK.

Fig. 1 shows the piece to be machined. The casting was a thin one, finely molded and cast, so that only 1-32 inch was left for finish on the faces of the three bosses where the first machining was to be done. This cut was on surface *a* and was made with an end mill in a vertical milling machine.

Fig. 2 shows the fixture with work in place on the chuck. This chuck was an old one, and the arrangement of the faces of the poles was very simple—*c* being one pole, *b* the other and *d* the packing between the two. The fixture performed two duties. In the first place, it provided a thrust for the mill to cut against, and, secondly, it completed the circuit for the magnetic lines of force from pole *b* through the central hub in either direction to the two outside surfaces and back to pole *c*. As will be seen, the work is too short to span the chuck, and the underside of the pad at one end of the piece is raised above the surface of the poles.

Plate *e* is made of sheet brass as a precaution against short circuiting—if I may use the term—the lines of force. The flat spring *f* riveted to it gives assurance that the outside hub of the work shall be centered in the V formed in one edge of the plate, and also forces the end against the stop-pin *g*. Steel piece *h* bridges the gap between the pad on the work and pole *c* of the chuck. This piece is riveted in the way shown in the end view, to the base plate of the fixture. It does not touch pole *b* at all. The whole thing is located on the chuck by two screws which enter holes in the faces of the poles. As these holes were drilled from a templet, the same screws can be used to locate future fixtures.

This simple arrangement has been used for some time in interchangeable manufacturing with complete satisfaction, and it is probable that the advantage of simplicity and rapidity which the magnetic chuck offers will tempt us to try this scheme still further on small work requiring light cuts. R. E. F.

Soft Hammers and Babbitt Ladles.

Editor American Machinist:

A cub, mauling a mandrel into a mill, missed a machinist. The hammer used was precisely like the one shown at page 479.

Few men in the shops will take time to properly fasten a handle into such a short-lived affair as a lead hammer. The right way is to cast them in, using a piece of pipe for a handle and spreading the end.

There is not a solitary reason for any shop making its own molds, any more than there is for their making their own hacksaw blades. The lead-hammer molds on the market are better and cheaper than the "dinguses" made in the shops.

For the benefit of the machinists working where no facilities can be expected, I show in Fig. 1 a way to make soft hammers with cast-in pipe handle. The mold is made of a piece of pipe, drilled and

split. Care must be taken that the handle is well closed in at *Z*. A dog will do to hold the halves of the mold together.

Long ago, one of your correspondents told us how to make an improved babbitt ladle. I send a sketch of it, Fig. 2, to help impress the idea on readers of this paper. A bar is cast across the snout, to make the ladle self-skimming. The ladle can be made with two snouts—better so for general shop use.

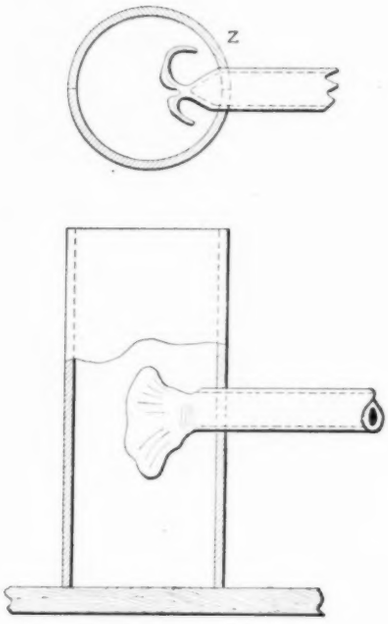


FIG. 1. A SOFT HAMMER MOLD.

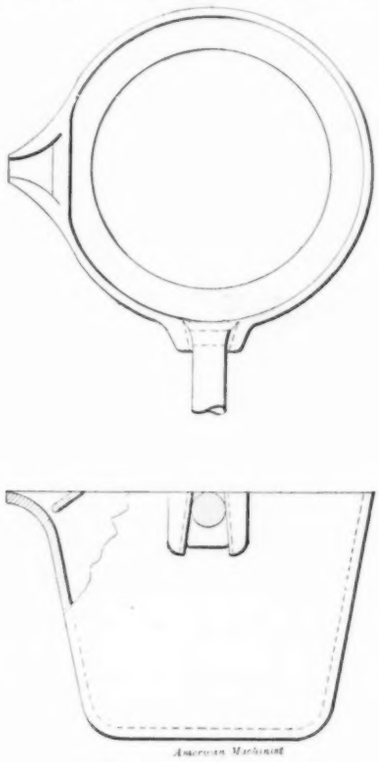


FIG. 2. A BABBITT LADLE.

A ladle in use is very hot. As a general thing, the handle is too warm for comfort, and a lot of cheap, or of expensive white metal is spilled about. This ladle has a detachable handle—simply a double dovetail.

It does no harm to add a lump of resin to melted babbitt just before pouring.

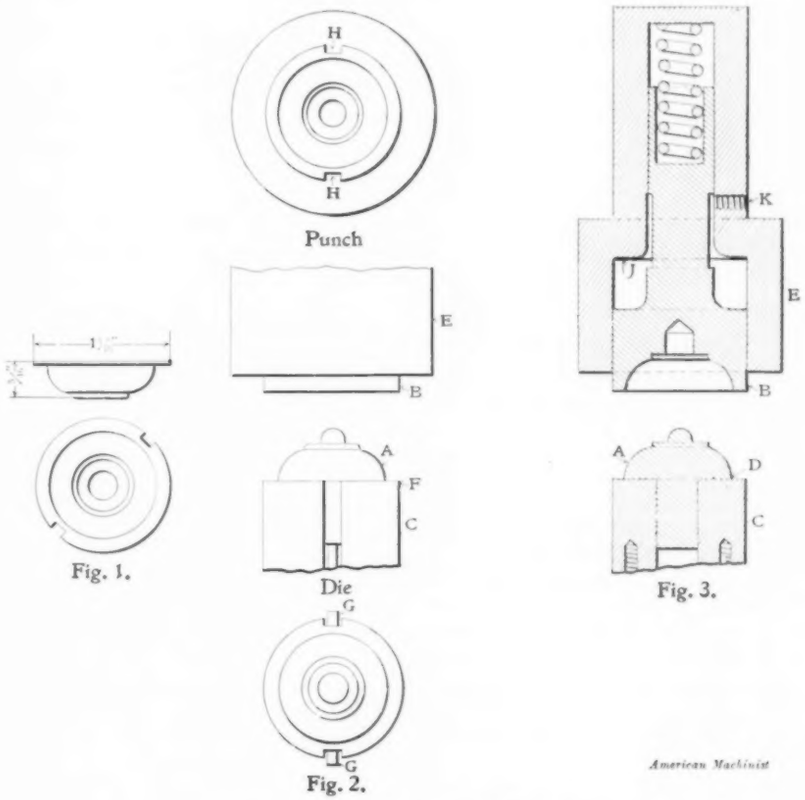
FERD. WERTHEIM.

Forming and Trimming Punch and Die.

Editor American Machinist:

Fig. 1 is an insulation lining for a sock t sh.ll base and is ma 'e of black fiber 1-32 inch thick. It is first blanked out in an ordinary round washer die, 1 13-32 inches in diameter, with a ¼-inch hole in the center. The blanks are then placed in a pan of warm water, to soften so that they will not split in the forming and trimming operation herewith shown. A blank is then placed at *A*, Fig. 2, and on the down stroke of the press it is struck by the forming punch *B* and formed to the proper shape, and *E*, coming down, trims off the lining at *F*. The punch and die are shown in section in Fig. 3. The part is bored out for *A* and grooved on opposite sides for pieces *G*, as shown in Fig. 2. *A* is a drive fit into *C*, and can be taken out to allow *C* to be sharpened by grinding across the face *D*. The steel pieces *G* (Fig. 2) are brought to a sharp point so that the trimmings, as they are forced down over *C*, are cut apart and fall out of the way. The part *E* is bored to receive punch *B* and the latter is held down to its place by the spring shown at the top, which is sufficiently short after closing up to allow *B* to come up to the face *J*. To prevent the punch from falling out, it is necked down and a screw placed as shown at *K*. The lugs to cut out the notches in the fiber are not shown in the sectional view, but are shown at *H*, Fig. 2. In making the tool in this way we get a perfectly round lining that fits the base at all points.

BARNEY.



FORMING AND TRIMMING PUNCH AND DIE.

An Appreciation of the Oil Country Echoes.

Editor American Machinist:

It has been said that "'Way Down Upon the Suwanee River" has rendered of interest scenes ordinary in themselves; that travelers view with awakened curiosity features of the locality which but for their association with Stephen C. Foster's plaintive song would have passed unnoticed.

Of a much more practical nature are Osborne's "Echoes from the Oil Country," but they have somewhat the same effect upon the reader. So intimately do we connect the "Echoes" with the places in which they were awakened that, upon looking from the car window as the train flits by, one instinctively falls to wondering which of these numerous derricks, standing like solemn watch-towers, have been visited and had their engines repaired under the difficulties so effectively described. Many tidy little machine shops are to be seen, any one of which might

pass for the one from which these familiar echoes arise. They are all willing to attack a range of work that would stagger some of their more pretentious competitors.

A feature which strikes the observer most forcibly is that they all have "fishing tools" for sale, in a country where presumably there are no fish to be caught. A moment's reflection brings the thought that the fishing referred to is done at the bottom of some of the deep wells beneath these innumerable silent derricks, standing each in its spot of ground, discolored by the oil which has escaped and trickled down the hillside, and whose only sign of life is the rhythmical movement of its roughly formed wooden walking beam.

Although the business of oil producing is no longer an infant industry, few of us, even though residing within a few miles of the derricks, have any over clear conception of the methods employed and the difficulties surmounted. Mr. Osborne could make some interesting echoes by causing them to arise not only from the Oil Country, but from an oil well itself; telling us something about the tools in use, their weight and proportions, their manner of operation, the size and weight of the casing and the depth to which it extends; how the sand is removed and how tools which have dropped in the well are recovered; how deep is the average well and how long it takes to drill, and how many men are engaged in drilling it; how many hours they work a day and how many other things are done which an outsider does not know enough to even ask questions about.

Nearly a score of years ago I met a farmer who was possessed of considerable information on a variety of subjects other than those pertaining to his own vocation, but for all that he supposed that oil and gas wells were dug with a pick and shovel. Readers of the AMERICAN MACHINIST are not liable to errors of this kind, but probably only a few of them are well versed in all the particulars of well drilling.

GERALD E. FLANAGAN.

Cutting Large Internal Gears.

Editor American Machinist:

The enclosed photographs and blueprint show how we arranged to cut large internal gears on a common spur gear cutter. The gear being cut at the time the photographs were taken was 70 inches pitch diameter, 2 diametral pitch, 4 inches face, and 75 inches outside diameter.

The drive of the internal cutter was taken direct from the regular cutter arbor which was fitted with a 3¼-inch pinion; the bracket shown in Fig. 3 for the arbor and gearing being bolted on the machine in place of the regular arbor support.

The two driving pinions, placed as shown in Fig. 2—one being put on each side of the cutter—and the spool-shaped idler gear make a powerful drive for the limited space. The radius of the top of the cutter bracket being only 15¾ inches this attachment when provided with a cutter 5¾ inches in diameter will cut internal gears from 32 inches up to 70 inches diameter.

The hight of the cutter center from the top face of the bed was such that, with a ring placed inside of the spider rim to carry the gear and the whole spider dropped down, an internal gear 66½ inches in diameter could be cut. This saved making a spider for holding this gear.

ERNEST J. LEES.

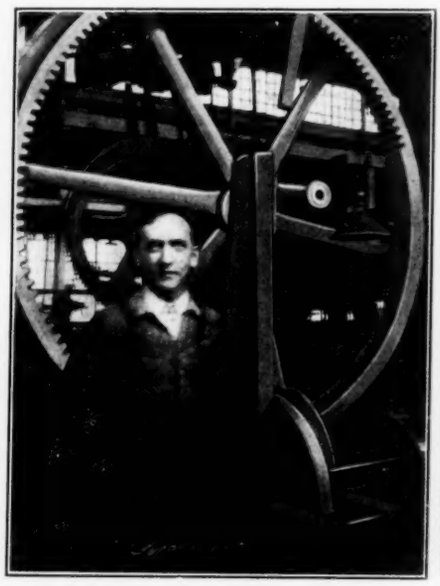


FIG. 1. CUTTING A LARGE INTERNAL GEAR.

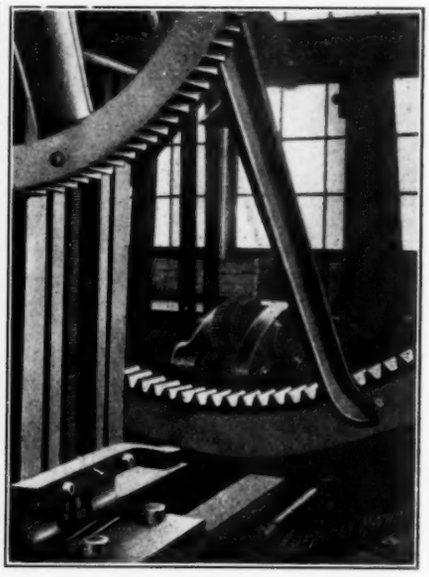


FIG. 2. SHOWING CUTTER HEAD AND GEARING.

Machine Wrenches.

Editor American Machinist:

While we are progressing so rapidly in machine design we are prone to overlook a great many small and apparently insignificant points. I have scanned the AMERICAN MACHINIST for a long time trying to see some article touching on the great number of different sizes of wrenches that usually accompany a machine. We have in our works a keyseater of an up-to-date type and I am sorry to say that its full equipment of wrenches numbers eight. There are four double-ended wrenches and the remainder are single; it is unnecessary for me to state the trouble a man has while setting this machine for work.

If he desires to adjust his cutter bar, a certain wrench is used; if he adjusts the stroke, another wrench is needed; if he adjusts the table, he needs still another wrench, and so on until he uses the full equipment of wrenches. Now, why all this trouble cannot be eliminated I cannot see

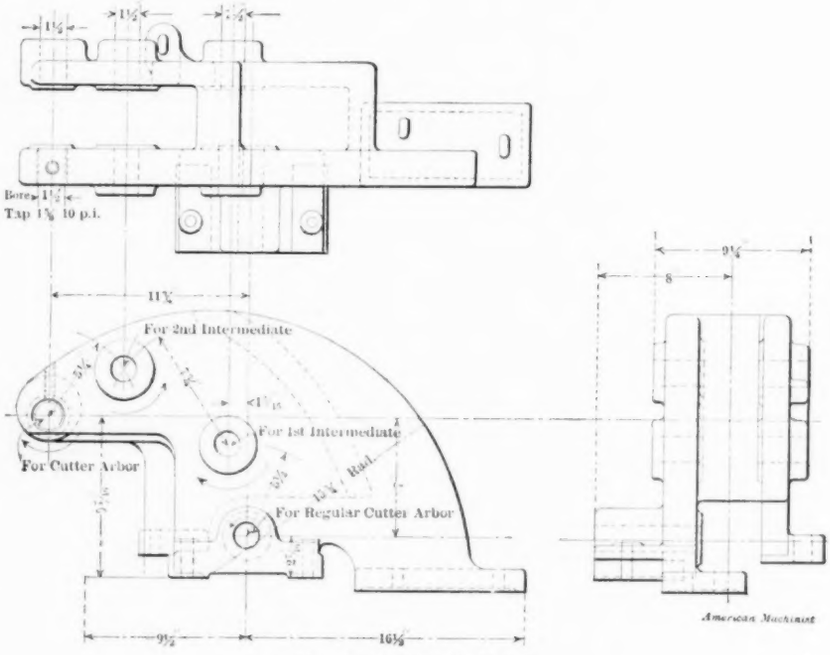


FIG. 3. CUTTER BRACKET.

for there is very little difference in some of the thread diameters.

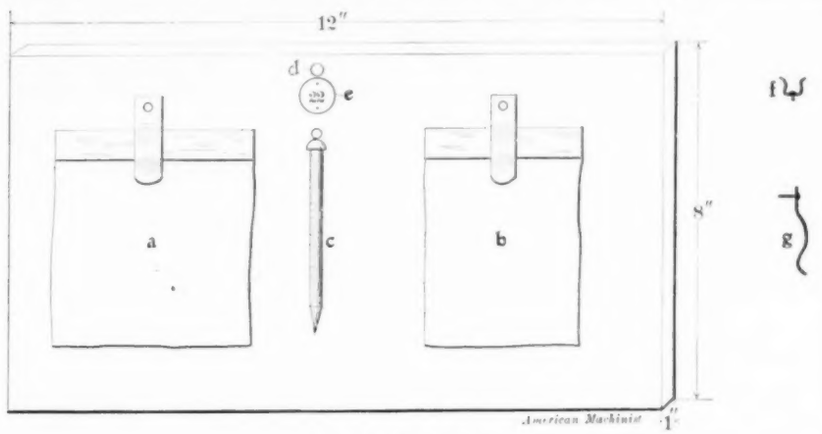
This matter is one of importance, for it takes altogether too much time for a man to pick up so many wrenches, often getting the wrong one, and the time consumed in this way amounts to dollars in a very short time. Outside of this trouble with the above machine it is all that can be desired, and if the number of wrenches was reduced one-half it would be the greatest addition to the shop, for we have cut keyseats in steel wheels 13-16 by 7 inches long in from three to five minutes, and they were absolutely correct. From the above it can readily be seen that after the machine is set it has unlimited capacity; but it is in getting it set that the time creeps in, and this trouble could be done away with to a great extent by reducing the number of wrenches.

S. P. Y.

A Neat Time Card Board.

Editor American Machinist:

Having charge of a shop and knowing how unhandy it is to keep time properly with only a block of time cards, I decided to have a number of boards made in a substantial way, one for each employee. As will be seen by the sketch, the board contains a block of time cards *a*, a block of note paper *b* and a lead pencil *c*, the pencil being fitted with an eraser, and all being held in place by spring clips *f* for the pencil and *g* for the blocks of paper. The board serves the purpose of a desk when the employee makes out his time and is hung in some convenient place during the time it is not in use, a hole being provided for this purpose at *d*. A check number is fastened on each board at *e* to correspond with the employee's check number. Over the block of time cards a piece of filler board of the same size as the time cards is placed, and on this are the words "Use this to keep time car 's clean." The block of note paper is used during the day to keep a detailed account of the time on each job, including the time of transfers, in case a job is interrupted, and in the evening the workman figures his totals and transfers them to the time card.



A TIME CARD BOARD.

HARRY ASH.

Belt Dressing and the Use of Belts.

Editor American Machinist:

There seems to be a considerable difference of opinion in regard to the use of belt dressing. Some authorities are for its use, others against; between the men in the shop the same difference of opinion exists, but, if anything, the majority are in favor of it. Until recently the only belt dressing used in England to any extent was rosin put on dry, or sometimes oil and rosin. Now there are several dressings on the market here—one brand, of American manufacture, which is put up in bars and is applied while the belt is in motion, I have found to answer very well; in fact, for ordinary machine-shop use, the best I have ever tried, being very handy and clean. The kind that is put up in tins, like treacle (molasses) has no charms for me.

C. Otto Gehrckins (by the way, I have had several attempts to pronounce the gentleman's name, but have not succeeded yet), of Hamburg, in a pamphlet published some time back, says: "The band leaves the driven pulley tensed; a certain part of the band must, while it passes over the pulley, thus change from a slack to a tensed state, it becomes longer by stretching on the pulley, consequently it must *move* on the pulley. Each attempt to impede this motion on the pulley must cause other inconveniences; therefore to attempt to prevent slipping by the use of rosin, rough pulleys, etc., must lead to bad results. The use of a little tallow or grease, carefully applied, which will permit and sustain this motion on the pulley, has proved most successful. The band moves, as we have seen, on the pulley; it moves quicker than the driven pulley, while it is moving the pulley by friction along with it. This motion of the band must not be confounded with the slipping of overcharged belting, or too slack belting, which will make a disagreeable noise if incapable of doing its work."

Personally, I have found that the good results amply counterbalance the bad results and inconveniences. If no dressing is used, the belt will have to be tightened to prevent slipping, which in turn causes heating of bearings. Whatever dressing is used should of course be of such composition as to suit the particular temperature and conditions of speed. If a belt runs in a hot and dry place it will require oil to keep it pliable, to insure proper adhesion to the pulley. Otherwise the belt will become dry and then crack and is soon spoilt.

CHERRY RED.

Birmingham, England.

Some Notes on Cutting Pipe Threads.

Editor American Machinist:

There is a lot of difference between cutting threads on round iron, as used for bolts, studs, etc., and cutting open-hearth steel when made into pipe. Blunt, square-ended cutters, or chasers, as machinists call them, will work O. K. on the former, and passably well on iron pipe, but when we come to steel we are up against a material, and in such a shape that it can only be cut satisfactorily with tools having sharp, thin cutting edges, like those of a twist drill, for instance.

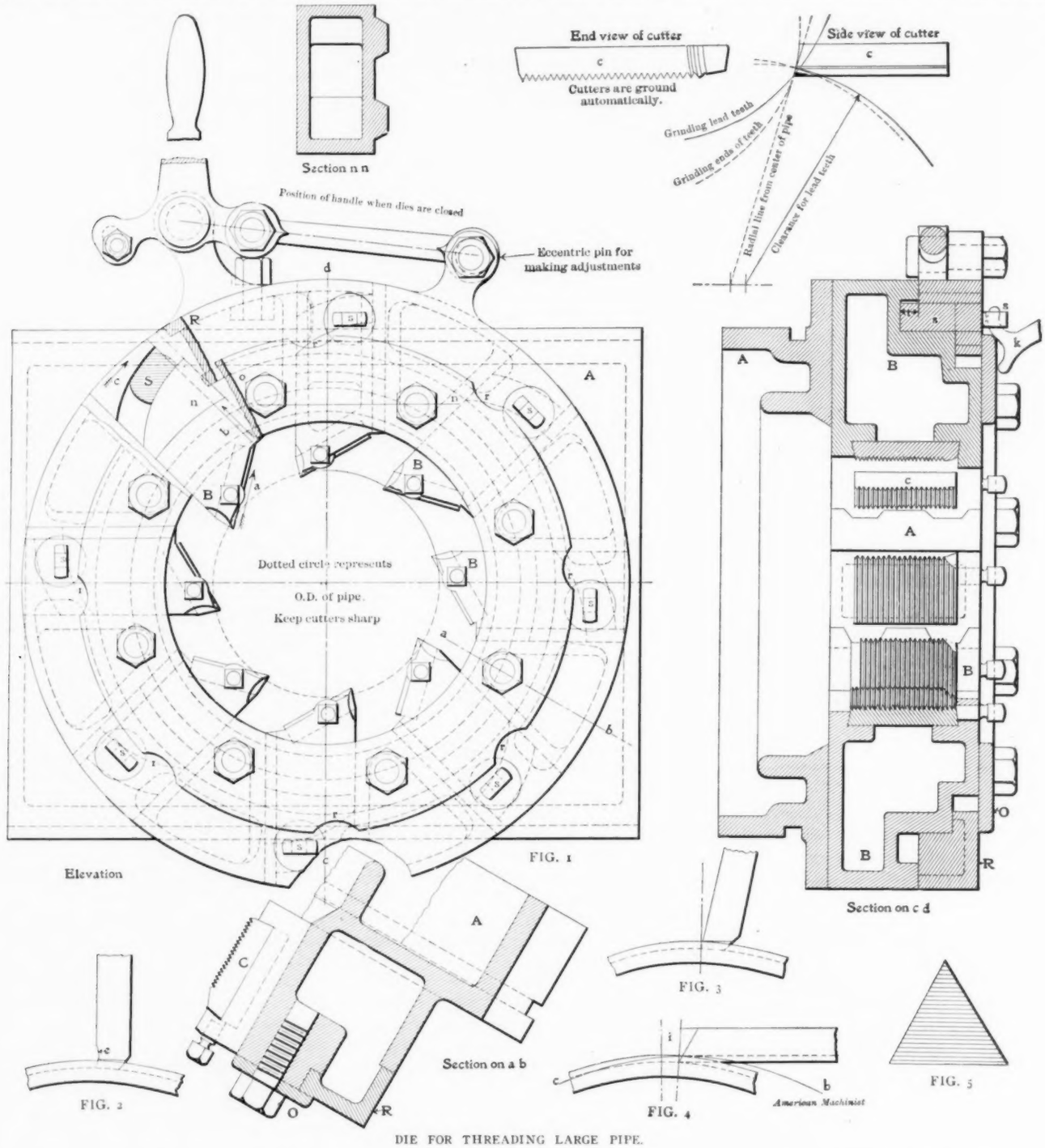
Fig. 2 shows a cutter with its normal face set radial to the pipe. If it is scooped out as at *c*, good work can be done with it, but, owing to the trouble and waste of the scooping-out process when it has to be re-milled, there is a manifest advantage in setting it with its face as in Fig. 3. In Fig. 4 the cutter is set the same as in Fig. 3, only it has the teeth cut on the side instead of the end, and has the advantage over both, as it admits of being sharpened repeatedly by grinding off the ends of the teeth. Then, also, the setting and grinding can be changed to get the best results without making any constructive change in the completed set, and further, the length of the teeth, or rather their number, remains constant from start to finish.

The spaces between the nearly horizontal lines, in Fig. 5, represent the proportionate depth of cut, when eight cutters are used in a set, pitch eight per inch, and three teeth tapered off for starting, making the depth of cut for each starting tooth 1-240 inch, or, approximately, once and a half the thickness of the paper that the AMERICAN MACHINIST is built on. This assumes that the difference between the top and bottom of the thread is 0.1 inch. One can easily see, by looking at the spaces in Fig. 5, the advantages that a thin cutting edge would have over a blunt one, and also see that the teeth following the starters have but a very little cutting to do, and that to grind them on the same angle as the starters their points would be too needle-like to stand well, hence all the teeth in the cutters cutting a full thread are ground blunt, or nearly at right angles to a radial line. The cutters are set back a distance marked *i* in Fig. 4 from a point tangent to the pipe, so that when the teeth are dulled, less grinding will be required to sharpen them. It also gives them clearance. The distance *i* is only given as an illustration. It is subject to change to accommodate the various diameters as well

as the material in the pipe. The line *c l* in this same figure shows the clearance for the starters, but not any exact amount. So much for theory, we are now up to construction.

Fig. 1 is an end view of a set of pipe dies, with the cutters arranged as in Fig. 4; in use the die is stationary and the pipe *a*, then a part of it goes up the incline, as shown by arrow *b*, then the pin *s* in the eccentric groove in the holder deflects it finally in the direction of arrow *c*.

The tendency of tools in general, when thin cutting edges are used, is for them to pull into the work, and, in cutting pipe, to stall the machine or punch a hole in it. by the movement of the handle in the upper left-hand corner, which is pivoted to the frame marked *A* and connected to the cam ring *R* by a rod, as shown. Adjustment is made with an eccentric pin in the end of the connecting rod. The pins *s* in the cam ring are shaped at the inner ends to fit the eccentric grooves in the



DIE FOR THREADING LARGE PIPE.

turns. At the top, at the right of the handle, is a section of the cutter holder on line *n n*, showing the V's on the back to prevent side play when the holder gets worn. The resistance due to the cut forces the holder back into the V's at both ends. First, the resistance is in the direction in which the pipe turns, represented by arrow

The ideal grinding and placing in position in this respect is when the tools will just feed themselves, when the only resistance to be overcome is that of the cut. It will be seen that the location of the slots for the cutter holders will control the gouging in tendency of the cutters.

The cutter holders are opened and closed

cutter holders, making the connection between the handle and holders complete.

The cutters are held in the holders with set-screws, as shown, and liners are put behind the cutters as they are ground off. The cutter holders are taken out of the slots by first pulling the cam ring around till the pins *s* coincide with the grooves r

in the guard ring *O*. Then with the lever *k*, the handle not shown, pull the pin *s* out the distance *t* or more, when the holder is free to be taken out through the center.

To get an idea of the strength required in their construction, the first set of 6-inch dies, very similar to the set described, was chucked to the face-plate of a lathe and a piece of pipe was entered and kept from rotating by pipe tongs with the end supported on scales. The horizontal distance from the center of the pipe to the point of support was 63 inches, and the weight on the scales averaged 240 pounds, when cutting a thread the full depth of the dies, which is 3 inches.

At the top and right of the figure an outline is given, showing how the cutters are ground on a universal grinder.

The teeth in the cutters are milled parallel to their edges, and the pitch angle is in the holders. This makes it possible to make cutters interchangeable, *i. e.*, the cutters from a sixteen set die make two sets for an eight set die, by taking the even numbers for one set and the odd ones for the other. The pitch angle is the only difference in the cutter holders. There are exceptions, of course; for instance, there is no use in using a wide cutter for an order for short threads, etc.

Youngstown, O. J. H. DUNBAR.

The Burden of the Old Men.

Editor American Machinist:

The English papers that have to do with trade affairs and which I have an opportunity to look over occasionally have a habit, which has become chronic, of reproaching American employers and the American industrial system, whatever that may be, for discarding aged workmen. It is represented, and I suppose believed, on the other side of the water that with us the bosses carry the matter to the verge of brutality, or a trifle beyond. Now it seems to me that our English friends are not quite correct in their actual information and are far out of the way in their deductions, and I have been looking for some American remarks upon this important topic, but as yet I have seen few. I feel quite certain that our side has not been fairly and adequately presented.

The attitude of our friends in this matter it is not altogether pleasant to contemplate. They tell their story with a whine and solicit the sympathy of mankind. They claim to be handicapped by their humanity, while we by sheer brutality evade their retarding conditions. I am so far from recognizing the correctness of their assumptions that I am prepared to maintain that the industrial handicap in the matter of the old men is really rather upon us than upon them.

It is, I suppose, a fact that you don't usually see men as old, or as many old men, in our shops as you do on the other side, but the shops are not the only places where you don't see them. You don't see them begging in our streets. There are quite a number of beggars in New York city, but it is practically impossible to find one who appeals for alms on account of his age. There are many blind, deformed and crippled and other evident victims of misfortune, usually young or not beyond middle age, but there are no merely old men begging because they are old and crowded out of employment. You don't find hem numerously in our almshouses nor the recipients of charity anywhere. They have either saved or otherwise accumulated enough to carry them or they are supported and provided for in other ways, most frequently by younger relatives, so that if they do drop out of our shops, or, as our friends say, are dropped out, the alternative with us is not beggary and starvation.

Now it seems to me there is evidence in this that the burden of the old men is upon the American worker rather than upon the foreigner. In the older countries the children, the women folk and, as long as possible, the aged generally contribute to the support of the family in a way that is not and never has been, and which I hope never will be, the fashion on this side of the water. With us to a much greater extent than in any other land the man of the family is the entire support of the family, so that when he is found bravely carrying not only the young children but also those too old to work he is to that extent more heavily loaded with life's burdens than in the older countries. If there are any who are envious of the apparently larger wages of the American workman, they should turn their attention to the larger expenditure involved in his different mode of life.

As to the alleged crowding of the old men out of the shops while still of considerable efficiency, there is one evident condition operative with us and not occurring abroad which may account for much of it. Our shops are usually themselves much younger than in the older countries, and there is also with us much more change of place by the volition of the workers, and it is therefore not to be wondered at that in the natural course of events and without inhumanity of design the older men should be fewer in American shops. You can't expect to find many men with a record of forty years of continuous service in a shop that is only twenty years old. We have to argue this matter from a strictly business viewpoint all through, and must regard the factory or the workshop as a business affair entirely and not at all eleemosynary. It is one thing to discharge an old employee when no longer so profitable as another, and it is quite a different thing to decline to hire an old man when his competitor for the place is young and fully capable in every other respect. The one who is most efficient, immediately and prospectively, is pretty sure to get the job in such a case in England as well as in America, or I am much mistaken. If this is not so and if our transatlantic friends would do differently they may be saints or simpletons, and we do not claim to be either.

As to how it might be in a long-established and continuously prosperous shop in this country, I take great pleasure in submitting a record kin 'ly furnished me by Mr. W. H. Sargent, of St. Johnsbury, Vermont, relating to the employees of the Fairbanks scale works in that town. I venture to challenge England or Germany, or all the world, to match this record. Mr. Sargent's statement follows.

TECUMSEH SWIFT.

LONG TERMS OF SERVICE IN THE FAIRBANKS SHOPS.

The veteran employee of the Fairbanks works is Col. Francis Walker, foreman of the foundry, he having served 57 consecutive years. Two of his brothers were with the company for a long time, the total term of service of the three being about 140 years. One of his molders has just resigned after 55 years of hard and heavy work.

The foreman of the polishing room has seen 53 years of service, the head blacksmith 38 years and the foreman of the machine shop 34 years. For 49 years the head of the finishing department has had to do with the assembling, sealing and finishing of scales, and one of his foremen, who has charge of the room where small scales are sealed, has been in this line of business for 46 years.

Forty-six years ago the present head of the experimental department came to stay for a month and has remained ever since. The foreman of one paint shop has had 40 years' experience, and the head painter in another room has swung a brush for 42 years.

Of course, it is to be presumed that the older and more experienced employees would be advanced to these positions of trust and responsibility, leaving to the younger men the hard work of to-day. "Old men for counsel, young men for war." But a glance over the ranks of the workmen themselves shows a considerable number of gray heads.

There are about 875 men in the manufacturing department, not including the farm or the store, which employ about 75 more men. About one-fourth of these have been here more than 15 years, as the following table will show:

50	men	have	served	between	15	and	19	yrs.
46	"	"	"	"	20	"	24	"
31	"	"	"	"	25	"	29	"
30	"	"	"	"	30	"	34	"
23	"	"	"	"	35	"	39	"
8	"	"	"				40	"
3	"	"	"				41	"
3	"	"	"				42	"
1	man	has	"				43	"
1	"	"	"				44	"
1	"	"	"				45	"
1	"	"	"				46	"
1	"	"	"				47	"
1	"	"	"				49	"

1 man has served		50 yrs.
1 " "	"	53 "
1 " "	"	55 "
1 " "	"	57 "

These men have been obliged to work ten hours a day for so many years because they were denied the opportunities and the advantages in the way of education which young men of to-day enjoy. Most of them have families, and it is a notable fact that their children have been given so good an education that they have invariably been able to command better situations than their fathers could gain. There is hardly an instance where a son of one of these veterans has followed his father into the shops.

Nevertheless these old men are not like the Man with the Hoe, "stolid and stunned, brothers to the ox." They are the leaders in all that is best in their village life. They are often represented on the board of school directors. The village and town officers are chosen from among them. Some are deacons in the churches and the white-headed foundryman has been a member of the legislature.

W. H. SARGENT.

The Premium Plan Accepted by the Trade Unions of Great Britain.

It is with the liveliest satisfaction that we clip the following from *The Engineer* of September 5. It is but another illustration of the fact, to which we have often referred in these columns, that this system has attracted more intelligent and serious attention in Great Britain than here. We are accustomed to look upon the Britisher as "slow," but he has crammed that word back down our throats, in this matter at least. We quote:

"After hanging doubtfully in the balance for some time, the question of the adoption of the premium system has been at last decided. On the 19th and 20th of last month a conference was held at Carlisle between the Executive of the Engineering Employers' Federation and the Executive Council of the Amalgamated Society of Engineers. The object of the meeting was primarily to discuss the working of the bonus system at Elswick, at the Central Marine Engine Works, and at the works of Messrs. Richardsons, Westgarth & Co., and Browett, Lindley & Co., but the representatives of both parties recognized the desirability of viewing the question on a much broader basis, and a general understanding on the bonus—or premium—system, as we prefer to call it—was therefore reached. Under this arrangement the Amalgamated Society consents to remove all restrictions on the working of the system, and, on the other hand, the employers agree to convey to those of their members who desire to adopt the system the following recommendations: First, that the time rate of wages for each job should in all cases be paid; secondly, that overtime and night shift should be paid on the same conditions as at present prevail in each district; thirdly, that a time limit after it has been established should only be changed if the method or means of manufacture are changed; and fourthly, that no firm should establish the system without intending to adhere to it. Agreeably to their promise, the Council of the Amalgamated Society recommended to their various branches that a fair and honest trial should be given to the bonus system, and the district councils, having taken a few days to consider the matter, have agreed to the recommendation of the central committee. The premium system is thus, at any rate, provisionally accepted by the men, and any manager is at liberty to introduce it without fear of trouble from that quarter.

"The recommendation which the Council of the Employers' Federation is to convey to its members, and which is briefly outlined above, seems to us to be entirely reasonable and fair. It must be remembered that the workmen are predisposed to regard the premium system as piece-work in disguise, and their representatives went to the conference determined to oppose anything which might seem to support that view. The curse of piece-work lies in cutting the rates. If rates once established were fixed forever, there would be no trouble. The trouble begins when a man earns more than appears to be a fair wage and the master reduces the price per piece. At that point the object of the plan begins to defeat itself. The workman knows that the master will stand his earning up to a certain amount and no more, and he is careful not to exceed that amount. The object of three out of four clauses in the memorandum, then, is to prevent the evils of piece-work. First we have the stipulation that the time rate of wages should be paid; secondly, that this limit should not be altered except under special conditions; and, thirdly, that, once started, the bonus system should be adhered to. The last clause is to guard against the danger that, the masters once having found out the capacities of a man and a machine by offering a premium, should return to piece-work and pay at the rate so established. The employers need quarrel with none of these clauses. It is of the essence of the premium system that a man need not earn a premium unless he likes; he may "take it easy" and earn his ordinary weekly wage if he prefers it. There is no compulsion. It is also a rule of the game that the time limit should only be changed when the conditions are radically changed. Even under those circumstances there is no great loss to the employers if it is left unchanged, provided the automatic premium system devised by Mr. Rowan is employed. Finally, there need be little fear of the masters giving up the system once they have tried it; it has too many advantages for that to be probable. The fourth clause in the memorandum we take to mean that, in addition to the pay and premium on the full hours he has worked on a job, the workman shall receive the extra quarter, half, or third—or whatever it may be—for every hour overtime. This is perhaps the simplest way of avoiding the difficulties that might arise if a job begun in the day, say, had to be finished at night. On the whole, then, we think that the representatives who were present at the conference are to be congratulated on the result of their labors. It is a sign of the times in the labor world that an amicable conclusion should have been reached so easily. There has been fair give and take on both sides. The employers have gained a point which will be of inestimable advantage to them, but so have the men.

"We cannot conclude without referring again to the decision of the men in the Manchester district to adopt the recommendations of their central council. We need scarcely say that it is with feelings of the liveliest satisfaction that we make this announcement. As our readers are well aware, we devoted early in the present year considerable time to making a full and searching inquiry into the working and advantages of the system. We endeavored to look at it impartially, and to arrive at a decision purely on its merits. We not only visited the principal works where it is in operation, but we put ourselves into correspondence with the able secretary of the Amalgamated Society of Engineers. We were thus able to look upon both sides of the question. The result of that inquiry was absolutely favorable to the system. We were convinced that, while it encouraged individual merit, it was not unfair to the less clever workman; that it gave the workman an increased interest in his work, and that, without being oppressive, it called forth his best exertions; finally, that it afforded him the opportunity of substantially increasing his wages. On the other hand, the master also profited, for, while he paid more in wages as a whole, the wage cost per piece was reduced, and his machine tools were used to greater advantage. He was thus in a position to lower his prices and to increase his works, and so find himself in a better position to meet foreign competition. We are pleased to know that the attention of employers was directed to the system by what we wrote, and that several were prepared to adopt it if they could be persuaded that trouble with their men would not result. Now that their minds are made easy on that point, we may hope to see the system widely adopted within the next few years."

A New Method in the Book Business.

A new way of handling a technical book business is being tried by the Derry-Collard Company, of 256 Broadway, New York. They assume that very few people who are likely to be interested in technical books are dishonest, or will fail to pay for what they get. They therefore send on demand, to any address, such

books as one may think he needs, for examination, without prepayment, security, references or anything else, but the request. If the book is what is wanted, the money for it may be sent. If the book is not what is wanted, it may be returned and "no questions asked." The outcome of the experiment will be watched with interest, and any of our readers are of course at liberty—in fact invited to take part in it.

Remarkable Flanging.

One of the most interesting manufacturing processes with which the writer has been connected is the production of glass enameled steel tanks at the works of the Pfandler Company, in this city.

These tanks are made of various diameters up to 7 feet 9 inches inside, and are built up of rings 30 inches high, with a welded longitudinal seam, each ring being flanged outward at the two edges and bolted to its neighbors.. The ¼-inch plates are first scarfed at the ends and then punched through the scarfs for a few 5-16 inch rivets to tack the joint in shape for welding. Next comes rolling up, then riveting; all of which is easy enough and without special interest; but at this point begins the special work.

The next operation is welding the joint. A weld, 30¼ inches long, of ¼-inch steel flange plate is not such an easy thing to make; but when that weld is in a big, flabby ring, 6 or 8 feet in diameter, weighing about 600 pounds, the difficulties are vastly multiplied. This operation is performed by taking a number of heats in a coke fire and closing about 6 inches of the weld at a time by striking overhand blows with light sledges. It is necessary to operate separately on the inside and outside of the ring in order to produce a perfect weld. Borax is used as a flux.

Then comes the flanging, which is really the most interesting of all the operations. The flange is 2⅛ inches wide, so that on a ring 6 feet 9 inches inside, the metal must be stretched 13.35 inches in a length of 255.25 inches, or 1 inch in 19.12 inches. When one realizes that this is being done cold, one gets a fair idea of the amount of punishment good steel will stand, and one's ideas of the flow of metals are somewhat broadened. One thing that adds greatly to the interest of this operation is the fact that the radius of the flange on the outside of the tank is only 1-16 inch. This alone would worry most boilermakers very considerably.

The flanging is done on a machine which is substantially a facing lathe of 9-foot swing, with the carriage and its track omitted and instead of them a roll, 12 inches in diameter by 4 inches face, so carried that it can be swung through an arc of a little more than 90 degrees. This roll has also limited movements in both radial and tangential directions.

The ring to be flanged is held in a chuck composed of three segments, one of which is fast on the face-plate, the second hinged to the first, and the third simply bolted to the other two, so that it can be lifted off by an air hoist when the ring is to be inserted or removed.

The ring being placed and the chuck bolted up, the roll is swung around until its axis is parallel with that of the work, then moved radially until it has entered the ring, and finally tangentially till it bears against the work. The terms radial and tangential are to be understood as being applied relatively to the principal motion of the roll in an arc of a circle in a plane radial to the work.

The work is now started, and as it revolves the roll is moved around, swinging about a point in space corresponding to the center of curvature of the flange, and gradually crowding back the metal until it lies against the mouth of the chuck. A little more tangential motion is then given the roll to flatten the flange, and then the roll is moved out of the way and a templet clamped to the work for marking off the bolt holes in the flange. This done, the ring is removed, turned end for end and the operation is repeated for the other flange.

The operation is simply spinning on a gigantic scale, the roll being substituted for the boxwood sticks used in that operation as usually conducted. About ten minutes are consumed in the actual production of each flange; but the handling of the machine and work consume considerably more time, so that a good day's work is about seven rings. While the description given may seem to indicate that the machine is quite a complicated affair, it is actually quite simple, in fact almost crude.

After flanging, the bolt holes are punched and the rings are sand blasted to give a clean surface for the enamel, the composition of which is a profound secret and which cost the company $30,000 to develop. The difficulties to be overcome were numerous, principal among them being the production of a poison-free enamel, and obviating the chipping and peeling off so common in enameled ware. It may be a matter of surprise to most readers of the AMERICAN MACHINIST that practically all enamels are composed largely of lead, and are therefore poisonous; yet it may be some comfort to know that the time during which food is in contact with enameled cooking utensils is not sufficient to make the danger a serious one.

Another difficulty met in enameling these rings is in their size, which greatly exceeds anything previously attempted by enamelers. At first it was found that the ring was burned at some spots before the enamel was fused at others. To overcome this, the furnace was rebuilt with a rotating hearth which is kept in constant motion till the enamel has been uniformly melted and incorporated with the surface of the steel.

A sample of steel coated with this enamel was subjected for six weeks to the action of muriatic acid, without deterioration, while a similar sample coated with the enamel usually used by makers of sanitary supplies was badly damaged by the same acid in three days.

After enameling, the tanks are bolted together, and here again a lot of difficulties were met and overcome in producing a tight joint. Rubber packing was found to give a taste to the contents. Usudurian was too hard to make a tight joint with the comparatively thin flanges. Canvas was tried and found unsatisfactory, and finally a special webbing was produced, which, when saturated with a suitable protective substance, met all the requirements.

The machinery and furnaces now in use are patented, Mr. Paige, manager of the works, being the inventor. A previous flanging machine had been produced by Mr. Rowland, of the Atlantic Iron Works, but was abandoned because the flanges were not flat enough to use without being straightened by hand. L. O. DANSE.

Detroit, Mich.

Mr. Sharpe's Foreign Trade Policy.

Editor American Machinist:

In an article entitled "Outlook for American Machinery in France," at page 1349, your correspondent, speaking of Mr. Lucian Sharpe, says: "His principle was to take care of the foreign trade *before* his home trade."

Allow us state our impression that the enthusiasm of the person interviewed has allowed him to incorrectly describe Mr. Sharpe's business practices. While he was always a believer in extending the markets for his products, he cultivated the foreign trade as a balance to the home trade, never placing it *before* the home trade, as your correspondent seems to think. He did his foreign trade upon practically the same basis as his home trade, filling orders in rotation as they were received.

BROWN & SHARPE MFG. CO.,
HENRY D. SHARPE, Asst. Treas.

The Otis Elevator Company has recently closed a contract with the Subway Construction Company for an escalator, or moving stairway, to be installed at the Manhattan Street Station of the new Rapid Transit road. At this point, the "subway" crosses the Manhattan Valley on a viaduct, the tracks being about 40 feet above the level of the street. The escalator will carry passengers both up and down, the two tracks being arranged in the same vertical plane. The guaranteed carrying capacity of the device is 20,000 people per hour, 10,000 in each direction. A motor of 35 horse-power will be sufficient to operate the mechanism when working at its maximum capacity.

Even in Sheffield they are are not quite sure as to "what is steel," and as a result of contention Professor Arnold will undertake to determine what is and what is not steel.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *27,000 copies are printed. Total for 1902, so far, 743,000 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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On the first of November the AMERICAN MACHINIST will have attained to the dignity of twenty-five years; its initial number having appeared November 1, 1877. In view of that fact we propose to make the first issue in November an anniversary number. In it we shall review the progress that has been made during the past quarter of a century in the leading lines of machinery, and specially illustrated articles will be presented from men who are very prominent in machinery lines. We shall compare the tools of 1877 with those made to-day, giving numerous illustrations of both periods, and the progress in tool building, locomotive construction, steam engines and boilers, marine engines, electric machinery, will be set forth by text and illustrations. It will be a number that no one at all interested in machinery will want to miss, and will be well worth preserving.

Manufacturers vs. Monopolists.

We cannot too strongly commend to the attention of our readers Col. Kilbourne's paper, an abstract of which we publish in another column of this issue. Here is a man of affairs—a manufacturer—who distinctly recognizes two very important truths: First, that workingmen, taken as a body, are much the same kind of men as those who are not workingmen and are influenced by much the same motives. Second, that there is an essential difference between a manufacturer and a monopolist—a difference which manufacturers themselves should never lose sight of, nor miss any opportunity of calling attention to.

It is far too common to class all large enterprises together as oppressors of the poor and grinders of other men's faces; entirely regardless of the plain fact that most manufacturing is carried on in the face of severe competition, and that many of the largest manufacturing establishments meet this competition and survive it only because of superior methods of management; selling their product at prices which make it impossible for less well-managed establishments to compete with them.

Most business men in America work pretty hard—pay little attention to social or economic matters; and, thinking they have no special reason for doing so, pay very little attention usually to anything not directly connected with their own business. It is easy for such men to be led into thinking that all who condemn monopolies or monopolists are enemies of wealth or would destroy all titles to property. While this is true of too many agitators perhaps, we cannot help thinking it is largely due to the fact that manufacturers generally take no pains to themselves distinguish between monopoly and legitimate competitive business enterprise or to cause others to do so.

Notwithstanding frequent statements to the contrary, we believe it to be true that a very large proportion of the manufacturing of the country is carried on by independent concerns competing sharply with other similar concerns. We believe further that even where most, or even all, of the concerns engaged in a given industry are united under a common ownership, still there is no harmful monopoly nor a condition that justifies the term monopoly, unless such concern controls supplies of raw material, or lines of transportation, or has some other form of advantage that prevents competition of other capital and other workers upon even and fair terms.

The history of manufacturing is full of instances in which large manufacturing establishments that for a time did all the business in a given line finally had to meet competition from new concerns that grew up from small beginnings in spite of apparent disadvantages; and, where a business is monopolized and large capital is required to compete in it such capital can always be obtained whenever a reasonable chance of success can be looked for.

On the other hand, there are real monopolies which must be dealt with in some way or other—monopolies from which manufacturers as well as others suffer—monopolies which he is indeed blind who fails to see that the people of the country are more and more determined shall be effectively dealt with. What we would wish to see is many more manufacturers like Col. Kilbourne, who clearly recognize the difference between a monopolistic enterprise and a competitive one, regardless of the size or of the amount of their capitalization, and who will clearly declare and point out the difference and refuse to be "bunched with the lot" and condemned for things which, instead of being guilty of, they generally suffer from, as victims.

We regard it as a grave mistake for a manufacturer to imagine that his interests are bound up with those of monopolists. The exact contrary is the truth when the situation is broadly considered. A people, including manufacturers, thrive best under conditions of freedom and equality of opportunity.

The Minneapolis Convention of Employers and Employees.

At the above-named convention, of which we published an outline of the program at page 1316, a good deal of gush regarding the brotherhood of man, the golden rule, etc., appeared, as might have been expected; but, nevertheless, some of the speakers who have been in intimate contact with labor troubles expressed opinions based on their experience which are noteworthy and important. Among those who spoke thus were F. W. Job, chairman of the Illinois State Board of Arbitration, and Herman Justi, commissioner of the Illinois Coal Operators' Association. Following are extracts from Mr. Job's paper:

"We find that when we have reached the point where we can get the employer and his employees to agree to meet and

reason together that they are always well on the road to reconciliation.

"One of the most important features of the present Illinois arbitration law is that which is covered by an amendment prepared by the present Board and passed by our last Legislature, which provides that where an industrial dispute occurs in which the public is affected, with reference to food, fuel, light, or the means of communication or transportation, or in any other respect, and neither party to such strike or lockout shall consent to submit the matter in controversy to the State Board of Arbitration, the Board after having first attempted to affect a settlement by conciliation shall proceed of its own motion to make an investigation of all the facts bearing upon such disturbance, and make public its findings with such recommendations to the parties involved as in its judgment will contribute to a fair and equitable settlement of the differences which constitute the cause of the trouble; and in the prosecution of such inquiry the Board has the power to issue subpœnas and compel the attendance and testimony of witnesses, as in other cases. Prior to this amendment to our law a labor trouble might involve all the people of a particular community, all the citizens of one of our outlying suburbs might be compelled to walk to the city because of a labor trouble on traction lines which the parties thereto would refuse to submit to us, and the Board would be compelled to sit with folded hands waiting to be called in. Now, however, it is different, and when such trouble occurs our Board proceeds to investigate it, and we find that public opinion invariably brings the guilty party to time. This is the nearest approach to compulsory arbitration found in any of the laws of the various States relating to the subject.

"We do not think that there is any short cut to the solution of all labor troubles. We do not claim to have a panacea or a specific or a patent medicine which will fix up every case. We do not believe that all cases can be settled, or even helped by our Board, and we especially think that we should rid ourselves of false hopes for an industrial paradise on earth, which none of us ever can, or ever will, see. We believe that theories alone cannot solve labor troubles or accomplish arbitration, but that it requires work, and lots of it, and hard work at that, and that we must all learn our lessons well from our experience, and when we have learned them profit by them and teach the other fellow. We believe that conciliation can do ten times as much as formal arbitration. Conciliation and getting people together to talk their own troubles over will, in almost all cases, accomplish the desired result. A formal arbitration, where it is settled not by the parties to the controversy, but by some third party, is never as good as a bargain made by the contestants themselves, but this same formal arbitration must be resorted to in certain cases, and it surely has a function, and there is work for formal arbitration. On the other hand, formal arbitration can be carried too far, for if every time a little trouble comes up an arbitration board should jump in and make a formal hearing, it would do more harm, in my opinion, than it would good, for it would lead both employer and employees in many instances to produce troubles for the sole and simple reason that perhaps a Board of Arbitration, or a single member of the Board, might help them out by deciding in their favor. There is one thing this Board does find, however, and that is that a great many employers and employees who formerly were the last to even think of the matter of conciliation and arbitration are now the most eager to take the matter up, and, in fact, are clamoring for it."

From Mr. Justi's paper we make the following extracts:

"We must cultivate that wise, noble, essential quality in our nature—the spirit of self-reliance. Break down confidence in self, or lessen the consciousness of our responsibility to ourselves and to our fellows, and we become a race of weaklings, shirks and demagogues, and the very institutions formed to prevent trouble become nurseries where trouble is fomented and demagogues and time-servers are created. If arbitration is made so easy that employer or employee can resort to it upon any question that may arise between the employer and the employee, the result will be that wherever it is believed any advantage can be obtained on one side or the other, the responsibility of settling questions in dispute will never be assumed, as it should be, by those immediately in authority or interest, or it will be imposed upon the arbiters. Thus arbitration will, in the very nature of things, soon go to seed and be in bad repute. No dignified plan of arbitration will ever be successful until all wise and honorable means have been exhausted in devising a simpler, quicker and equally fair method of settling the vast majority of such disputes as arise from day to day.

"Under existing conditions I do not know that the strike in the anthracite field could have been averted, but I do believe that it has been prolonged by an utter absence of tact on the part of the operators and by the intermeddling of well-meaning parties who have considered themselves specially qualified to adjust the dispute. Political intrigue and interference have not helped in the present instance, nor will a wise precedent be established for the future, should the present strike be terminated through such an agency.

"In the coal-mining industry of Illinois, arbitration by outsiders would be well-nigh impossible, whether the interests of employers or employees are to be considered. Why? Because in the coal industry of Illinois certain fixed or accepted principles of political economy were thrown overboard long ago. It is no longer a question of the survival of the fittest—a question of natural conditions—a question of the earning capacity of the workmen; it is the competitive conditions which must be taken into consideration in order to determine the scale of wages for mining coal; it is a question of giving or of dividing work in mines and among miners in the different coal fields of the State. Arbiters not thoroughly familiar with all the details of coal mining or with the peculiar conditions of the coal-mining industry in Illinois might succeed in either arbitrating some of the operators out of business, or in arbitrating a large number of deserving workmen out of employment, because most men not in the industry itself would be governed by the general laws of trade or of political economy. Is it surprising, therefore, that corporations representing great industrial interests, or labor organizations representing the sacred and vital interests of laborers, hesitate to arbitrate, and especially to arbitrate through an alien body?

"All talk of arbitration or anything akin to it is well-nigh idle, unless we take account of organization—not only as applied to employee, but organization as applied to employer. Whether we oppose it or favor it, organized labor has come to stay, and it must therefore be considered because we must deal with it. The employer class must organize to a point of excellence and efficiency where organized labor will respect it."

Frank L. McVey, Professor of Economics at the University of Minnesota, read a paper on "The Economic Effects of the Eight-Hour Day," in which he said:

"The wear and tear upon human life steadily increase under modern methods of production. If men are to stand as heads of families, as electors, and even as operators of machines, they must have time for rest, for education and for family life. The responsibility of government increasingly falls upon the working classes in a democracy. Shorter hours of labor alone can give the worker the leisure for the careful study of present-day problems, thrust more and more upon the electorate for decision."

Julian V. Wright, of the National Cash Register Company, described the methods of that company at considerable length, but as our readers are already familiar with them, an abstract of his paper seems uncalled for.

John Bates Clark, Professor of Economics at Columbia University, read a paper on Compulsory Arbitration, the essence of his views on this topic being as follows:

"For state socialism it is safe to say the majority of us are not ready, and even if it were to come, it would bring with it a condition in which the rewards of labor would have to be fixed by some official body. The process would be far more arbitrary than is that of the tribunals

which in Australasia adjust the terms of employment. If the plan of doing this by contract between employer and employed is to continue at all, the State must choose whether it will or will not give some recognition to the claim of organized laborers to their tenure of place. If it denies this right, strike-breaking should go on under the protection of the State, and without hindrance from any other power. If it recognizes the right, the State is the only agency that can properly enforce it. The State must say when a body of workers may be thrust away from the mills, the mines, or the railroads where they have been working in order that a new body of men may be put in their places. There are considerable grounds on which it might be right to thrust them out. If they are acting arbitrarily and unjustly, if they are restricting the number of their members, and demanding abnormal rates of pay, they are acting as monopolists, and there is no ground for protecting them; but if their demands are reasonable, it is in order for some competent authority to say so, and to insure them, so long as they continue to so act, against a loss of their places. This is the essence of the only compulsory arbitration that I am willing to recognize as practicable. It hinges on that claim to a tenure of place which organized workmen assert and vindicate in their own irregular way. It legalizes this right to the extent of protecting from eviction men who accept terms that are pronounced just, but it leaves men who reject just terms to go elsewhere and shift for themselves. Compulsory arbitration might easily go beyond this, and it has been supposed by many persons that it would do so, and that it would encounter constitutional difficulties."

Charles Zeublin, Assistant Professor of Sociology at the University of Chicago, took for a topic "The Relation of the Public to Capital and Labor," from which we make this brief extract:

"When one sees the financial and physical dominance in municipal affairs of the transportation systems, or witnesses the encroachment on the life of the citizen of ill-paved and unclean streets, or observes streets frequently torn up to make place for wires and pipes of various kinds, or is oppressed by too frequent vistas of a miscellaneous collection of telegraph, telephone, electric-light, gas, and trolley poles and standards, to say nothing of the ubiquitous signboard, one is inclined to wonder when the preparations are to be completed and life is to begin. The discontent of the citizen increases if he sees public officials serving the corporations at the expense of their constituents, health commissioners more solicitous for the landlord than for the tenant, smoke inspectors derelict in duty, while influential manufacturers and apartment-house owners ignore the well-being of the community, public library trustees accepting benefactions designed for the public and then restricting the use to a favored few, school board members resenting advice given to them by the public which pays for the schools, or park commissioners instructed to provide playgrounds for the children, but possessed by an infatuation for grass.

"Public ownership provides for the coming generation, and thus fulfils the community's law of life. The superior experience and more immediate interests of private capital make for energy and sometimes for efficiency, but there is no permanence. One of the most serious difficulties involved in the private performance of services which are essential to public welfare is the fact that the individuals in control, however honest they may be, have no inducement to make provision for the needs of the coming generation. Thus the community is frequently saddled with burdens which remain a tax upon the resources of a generation in no way responsible for these actions. Franchises which extend beyond one generation are utterly indefensible. There is an abundance of experience to prove that the life of one generation is long enough to provide adequate remuneration for such investments, and the numerous injustices worked by any greater extension of such franchises furnish sufficient evidence in favor of short franchises and subsequent public ownership. The municipality possesses immortality as no individuals or corporations can, and its interests, even more than those of a family, must be anticipated, so that the coming generation may not be sacrificed for the present."

Col. James Kilbourne, of Columbus, Ohio, president of the Kilbourne & Jacobs Manufacturing Company, read a paper on "Some Phases of the Labor Question," describing briefly the general course of conduct towards the firm's employees. Its policy, in general terms, is to accord the same treatment to those employed by it at daily wages, that is shown to its officers and salaried clerks. This applies to vacations, to advancement in wages for merit and length of service, to allowance for illness or injuries, and to all other relations.

"If an employee is injured or seriously sick, he is allowed half or full pay, according to circumstances, without reference to whether the injury was through his own or the company's negligence. If injured seriously, he is sent to a hospital, not placed in the general or free ward, but in a private room, under a paid physician, with instructions to give him every care that would be given to an officer of the company. In several instances old employees, unable to bear the expense themselves, who have developed symptoms of pulmonary disease, have been sent to North Carolina or Colorado, at the company's expense.

"In the employment of men no difference is made on account of color, religion, or politics, and no one is ever asked whether he is or is not a member of a union. Many of the employees are union men, but the greater number are not; between these there has never been any evidence of unpleasant feeling."

Speaking of improved factory regulations, the speaker said:

"Common humanity demands that employers of labor should take every practical precaution against bodily hurt to their employees. While the number of those employers who do not recognize, or do not care for their responsibility for the well-being of those under them is, under the advancing humanitarianism of the age, rapidly diminishing, the number of those careless of the safety of their employees, and who will remain so, unless compelled by the law to do otherwise, is very large. Even if every manufacturer, every railroad president, and every mine owner, were alive to their duty in this respect, public supervision would still be desirable."

On the subject of Trusts he said:

"It is quite a common belief that the evil inherent in trusts is not combination, but overcapitalization. Combination, it is said, brings with it great advantages. It economizes in cost of production, prevents ruinous competition, and, therefore, compulsory lowering of wages, and secures firm prices to consumer and producer. The evil they say is that the trusts by overcapitalization put an excessive value on the properties combined, and that in undertaking to pay dividends and interest on the stocks and bonds, they seek to take the unearned interest out of either the wages of the laborer or the price paid by the consumer. This is undoubtedly one of the great evils, for the bonded debts of these corporations will be a perpetual burden on the public, but so far as workingmen are concerned, they would be in danger whether the trusts are overcapitalized or not, the overcapitalization, of course, aggravates the evil. It is *monopoly* that gives the power to regulate wages, overcapitalization merely adds an additional incentive for lowering them.

"I am not opposed to large corporations, where no monopoly results, and I can conceive of combinations that would be beneficial not only to the parties combining, but to their employees and the public at large. But the overcapitalization trusts of to-day are practical monopolies. They are a menace to our prosperity and to the independence of laborers. It is becoming a very common belief that while both of the great political parties declare against them in their platforms, nothing will be done to crush them, or effectually control them, and it is held by growing numbers that the tendency towards their promotion is so universal that it must be grounded on economic and moral necessities.

"While there is an increasing number of employers who recognize their true obligations as such, and who are as sincerely concerned in the advancement of the interests of laboring men and women as they

themselves are, and while there is a growing opinion in the world that the man who does not deal fairly with those he employs to aid him in building up his business, is a man to be shunned by his manlier brothers, organization of labor is still necessary in a multitude of cases to insure fair treatment and just wages. Enlightened public opinion is coming more and more to recognize the necessity for such organization, and to recognize the fact that 'even if the gains from it were much less than they are, and the dangers greater than they are, it has the promise of better things.' . . .

"While between labor and capital there may be and should be peace—between labor and monopoly, there can never be anything but war. The strike in the anthracite coal mines may be stopped for a time by the exhaustion of either party to it, but the strife will never be definitely settled while a few individuals, claiming divine authority, assert the right to control a necessity of life, the gift of the Creator to all his children, and to do with it as only they see fit. . . . Let the laboring man remember that liberty under the form of law is his greatest earthly inheritance; of more importance to him than it is to the rich. Let him be careful, as careful of the rights of others, as he is of his own, and in the end he will surely be triumphant, helping the coming of that happy day, which may God speed, when lockouts and strikes shall be no more, because all men shall recognize and obey the obligations that pertain to the universal brotherhood of man."

Noteworthy among the papers are those by Messrs. Job and Justi, who, from their positions in life, are brought face to face with concrete phases of the subject. Noteworthy as disappointments are most of the papers from college professors and the professional leaders in the "social betterment" movement. While Messrs. Job and Justi had suggestions to make which are capable of application to the problems which arise, the other class of papers dealt largely with glittering generalities and will soon be forgotten.

A firm of selling agents, who had represented one of the manufacturing companies now included in what is called the Steel Spring Trust, has sued for an injunction against the trust to prevent the breaking of a contract made with the constituent company before the combination was formed. The selling agents had made contracts with railroad and other corporations and the threatened action of the trust prevents these contracts being carried out, and works injustice.

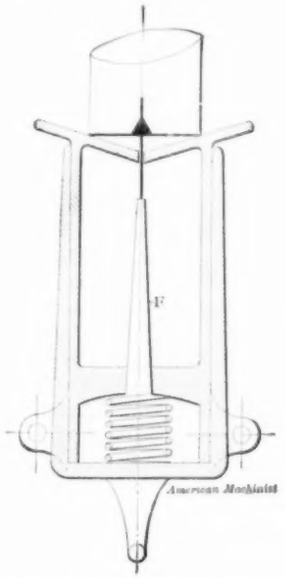
The National Machine Tool Builders' Association will meet at Cleveland, with headquarters at the Hollenden Hotel, October 14 and 15.

The Columbia bicycle factory in Hartford has been closed indefinitely. Only about 125 men were employed there.

Some New Things.

CENTER CLEANER.

Every lathesman knows the difficulty of being sure that the centers in his work are clean and clear of chips and also the time consumed in making them clean. The device illustrated herewith is intended to remove this difficulty. It consists of a cup within which is placed a hollow plunger, which is normally held at some little distance from the bottom of the cup by the helical spring shown. The cleaning fluid, which may be benzine, kerosene, soda



CHRISTMAN CENTER CLEANER.

water, oil, or a mixture of these (where cleansing and lubricating are intended to be done at the same time) is placed in the lower chamber, and when the work is placed within the cone at the top of the plunger (which centers it) and is pressed downward a strong stream of the cleaning fluid is forced upward into the center as shown, thoroughly washing out all chips and dirt. The chips fall into the interior of the plunger and may be removed by dumping, this being necessary only at long intervals. The device is so made as to be conveniently attached to the lathe or elsewhere, and is made by A. B. Christman, 1086 Central avenue, Cleveland, O.

Personal.

Wm. H. Wiley, the publisher, and treasurer of the A. S. M. E., has been nominated for Congress by the Republicans of his Congressional district in New Jersey.

Mr. James C. Hemphill, of the Rogers & Hemphill Machine Company, manufacturers of vertical boring mills at Alfred, N. Y., has sold his interest in the above company to Mr. Rogers, who will continue the business.

Obituary.

Isaac A. Singer died suddenly at Atlantic City, N. J., September 26, sixty-five years old. He was a stockholder of the Singer Sewing Machine Company, but had not been connected with the active management for many years.

Harry S. Parmelee, inventor of the automatic sprinkler and a wealthy manufacturer of New Haven, Conn., died on board a cruising yacht at Brooklyn, September 26, fifty-eight years old.

Commercial Review.

NEW YORK, September 29.

The month of September in the machinery industry was characterized by an excellent volume of business. Large interests were especially favored with some good orders, while smaller houses express satisfaction with the business they did. Railroads were particularly heavy buyers, while industrial concerns gave substantial orders. Deliveries have for some time exercised considerable influence on trades, but never more emphatically than recently. The house in a position to insure quick shipment of machine tools can command considerably more business than one that is not, and not a few orders have been placed with this fact strongly in evidence. The outlook for trade is regarded as satisfactory, and many machinery houses tell of bids they have made and will shortly make, which will certainly result in some good orders.

In trade circles during the past week considerable comment was heard in reference to the report that the United States Steel Corporation had decided not to sell its raw material, such as iron ore and coke, to outside interests. That such a policy, if adopted, would be a serious menace to the iron and steel industry in all its branches is obvious. Inquiry at the company's offices did not result in any tangible information concerning the report being obtained, but the consensus of opinion is that there is no truth in it—at any rate, for the time being. Later the following statement, said to be authorized, was made:

"It has been the policy of the corporation since its formation to deal very liberally with the independent companies. It has sold freely of its raw material to these companies whenever it could be spared. Everyone familiar with the iron and steel trade knows that for some time there has been a great scarcity of pig iron, and that owing to the strike of both the anthracite and bituminous miners there has been a considerable scarcity of coke for some months. In view of these facts, it is evident that the United States Steel Corporation would not sell these products to outside companies when it was likely to be short itself.

"All along the management of the United States Steel Corporation has welcomed the competition of the independent companies, and at no time has posed as a trust. While the corporation has a strong hold on the iron and steel trade, recent figures compiled and published by Mr. Swank, of the American Iron and Steel

Association, on what he claims were official data, indicate that the total output of the independent companies is considerable.

"A prominent manufacturer of pig iron said only a day or two ago that all the pig-iron manufacturers of the country were favorably disposed toward the United States Steel Corporation, and that they had always received fair treatment from the latter. It is known that during the last year the corporation has bought considerable pig iron from outside manufacturers.

"One in a position to speak with authority says that he has no idea that the corporation will change its policy with respect to the independent companies in the future."

Some big orders for machine tools by the Pennsylvania Railroad Company are among the possibilities of the near future. In addition to the $2,000,000 recently authorized by the officials of the company for the improvement of the shop facilities at Altoona, it has been decided to spend $500,000 more in carrying out plans for the betterments at that point. It is the intention of the company to erect three new departments, one of which will be a wheel foundry, larger and more complete than the two now in use. A roundhouse for the Pittsburgh and Midland divisions will also be erected at Altoona. It is the ultimate intention of the company to manufacture all its own engines and cars, and to this end the enlargement of the shop facilities has been authorized.

Judge Lacombe, of New York, on Friday, granted a restraining order upon the application of the Chicago Pneumatic Tool Company, restraining the Philadelphia Pneumatic Tool Company from making, selling or using tools in infringement of the Moffet plant, owned by the Chicago Pneumatic Tool Company, until the further order of the court. An injunction had previously been issued against the Franklin Boiler Works, a user of one of the infringing tools manufactured by the Philadelphia company, but the latter company claimed that, as this injunction was not against them directly, they were at liberty to continue to manufacture and sell such tools. But Judge Lacombe's order now prevents them from further infringing the Moffet patent. The defendants are required to appear before Judge Lacombe in October and show cause why a permanent injunction should not issue against them.

The scheme for the reorganization of the Driggs-Seabury Gun and Ammunition Company, of Derby, Conn., having failed, the plant will be sold. It is said that the United States Shipbuilding Company has made an offer of $500,000 for the property, and the creditors have decided to wait for a week or so in order to hear definitely from the company regarding the offer.

The Diamond Drill & Machine Company reports its almost complete recovery from its recent fire, and expects to have both its new steel plant and its new iron foundry in successful operation within the next two months at the most. It has practically secured all the equipment and is rapidly filling orders. It is also building a large blacksmith shop, and is doubling the capacity of its electric light plant, also its boilers and engines.

The Philadelphia Pneumatic Tool Company reports that in the month of August they broke all previous records in the amount of goods shipped, although from present indications September will establish a new record in that respect. Recent large orders have been received from the Cambria Steel Company, Pennsylvania Steel Company, New York Shipbuilding Company, Newport News Shipbuilding & Dry Dock Company, and Grand Trunk Railway Company. Foreign orders have been received from Paris, London and Copenhagen. More orders have come in for rotary drills during the past two months than ever before. This company has just added to its machine-shop equipment eight engine lathes, two automatic machines, two turret lathes, two grinding machines, one Fellows gear shaper, six drill presses, one universal milling machine, one twist drill grinder and a number of other minor machine tools.

The United Shoe Machinery Company has decided to accept the offer made by the city of Beverly, Mass., to build a huge plant to cost $750,000 and to occupy ten acres and employ at least 2,000 operatives. The company has organized a committee to carry on this work. The plant will include an administration building, 60x80 feet, three stories high, two parallel main manufacturing buildings, 600x60 feet, three stories high; a storage building, 400x60 feet, three stories high; a drop forge, blacksmith, die sinking and hardening plant, 60x220 feet; a 20-ton daily foundry plant, and a central power plant of 1,800 horse-power. Industrial and underground railways will connect the various buildings and the whole plant will be electrically driven. All the factories will be consolidated in this big plant.

"Labor Conditions in the United States" is the subject of a chapter in the recently published report of the commission from the British Iron Trade Association which visited the United States a few months since and reported upon industrial conditions, and especially those relating to iron and steel. Discussing this important question of the condition of labor in the United States, as viewed from the standpoint of the English citizen and manufacturer, the report, among other things, says:

"The human factor and the personal equation appear to count in the United States for more than they generally do in Europe. Workmen appear to enjoy a larger measure of independence, based on the knowledge of the fact that work is more easy to obtain than in older countries; that they are able, as a rule, to save money, and are, therefore, less dependent than when living, as is not unusual in Europe, from hand to mouth, and that they are living under a political *regime* which is founded on democratic principles.

"Two features of the relations of employers and employed may be named as exercising a powerful influence on the amity of their connection—the first, the encouragement and reward of workmen's inventions, and the second, the readiness with which workmen of exceptional capacity can themselves become employers and capitalists."

Pawling & Harnischfeger, Milwaukee, Wis., advise us that the demand for electric cranes and hoists continues very satisfactory. Recent sales made by them include the following: Davenport Foundry & Machine Company, Davenport, Iowa, one 5-ton crane; Alan Wood, Iron & Steel Company, Conshohocken Pa., one 15-ton crane; Smeeth Copper & Bronze Company, Chicago, one 10-ton crane; Copper Queen Consolidated Mining Company, Bisbee, Ariz., three 10-ton cranes; American Sheet Steel Company, Cambridge, Ohio, one 30-ton crane with 5-ton auxiliary hoist; International Harvester Company, Deering Division, Chicago, two special 5-ton hoists; Vulcan Crucible Steel Company, Alliquippa, Pa., one 15-ton crane with 3-ton auxiliary hoist; American Sheet Steel Company, McKeesport, Pa., one 30-ton crane with 5-ton auxiliary hoist and one 10-ton crane; Greenslade Foundry Company, Milwaukee, one 15-ton crane; American Foundry & Construction Company, Pittsburgh, one 3-ton crane; Reading Iron Company, Reading, Pa., one 10-ton crane; Canonsburg Steel & Iron Works, Canonsburg, Pa., one 25-ton crane with 5-ton auxiliary hoist; The Holthoff Machinery Company, Cudahy, Wis., one 3-ton hoist; Allis-Chalmers Company, Milwaukee, for Sanitary District of Chicago, one 15-ton crane; The McConway & Torley Company, Pittsburgh, Pa., one 2-ton crane; Brown Corliss Engine Company, Corliss, Wis., one 30-ton crane with 5-ton auxiliary hoist; Gisholt Machine Company, Madison, Wis., one 10-ton crane; The Milwaukee Electric Railway & Light Company, Milwaukee, one 5-ton special hoist; The Standard Steel Works, Burnham, Mifflin County, Pa., one 10-ton crane; Christensen Engineering Company, Milwaukee, two 10-ton cranes; Hanson & Tunelius, Chicago, one 1½-ton hoist-crane; Sterritt-Thomas Foundry Company, Pittsburgh, one 10-ton crane; The Elyria Iron & Steel Company, Elyria, Ohio, one 15-ton crane.

CHICAGO MACHINERY MARKET.

Machine tools have not been selling in the West during September quite so well as they did in August. That statement seems warranted by reports, but there is not much margin to go on, by which is meant that it is rather a close guess, whether or not September did not keep up with the previous month. About half the representatives of machine-tool makers

here say there has been a decline; the other half say business has either kept up or has shown some little gain. One salesman who has just returned from a trip in the Northwest says there is among buyers a more conservative feeling. There is no shrinking in their own business, but they do not seem to be quite so sure that the brisk trade is to continue indefinitely, so they are not preparing so extensively to take care of an uncertain increase as they did a few months ago. This same conservative feeling may be encountered elsewhere. What its basis is is past determining. One factor that enters into it is doubtless the fact that trade has been so good during the past two or three years that its continuance on the same scale is deemed very unlikely. The unreliability of that basis is shown by the fact that a year ago many business men talked the same way.

But the decline in the sale of machine tools, if any, is not marked. Those representatives and agents whose business has dropped off say it has been perhaps 10 per cent., whereas those who make contrary report point to encouraging circumstances. One of these is that current business consists largely of small orders, denoting a wider and more general buying. Another is that much of it comes from unexpected sources. When the buyer wants a machine tool he goes and buys it without much, if any, preliminary negotiations.

There have been, however, a few good-sized orders. The Deering Harvester Company has been a liberal purchaser of machinery during the past few weeks. They are said to have bought the machinery for the new rolling mill to be erected at South Chicago, and in addition many tools for an addition to their harvesting works. The Milwaukee Harvester Company also has been a good buyer of machine tools. The Colean Manufacturing Company, Peoria, Ill., has bought a shop equipment of some considerable amount for the manufacture of agricultural implements. The National Drilling Machine Company, Barberton, Ohio, is another late purchaser. The railroads continue to buy steadily, and there are several contemplated outfits of considerable size awaiting the machine builders.

The sale of wood-working machine tools also shows a decline as compared with last summer months.

Quotations.

NEW YORK, Monday, September 29.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:

No. 1 X	$23 50 @ $25 00
No. 2 X	22 75 @ 23 50
No. 2 plain	22 25 @ 22 50

Southern:

No. 1 Foundry	22 00 @ 23 00
No. 2 Foundry	21 75 @ 22 50
No. 3 Foundry	21 25 @ 22 75
No. 4 Foundry	20 25 @ 21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11½ @ 11¾c.; electrolytic and casting, 11.35 @ 11.55c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 25⅜ @ 25¾c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5⅝c.

Antimony—Cookson's, 10c.; Hallett's and U. S., 7½ @ 7¾c.

Lard Oil—Prime City, 78 @ 82c., according to brand and quantity ranging from one barrel up to large lots.

Manufacturers.

The Union Fire Arms Company, Toledo, O., will enlarge its plant.

The Weinman Machine Works, Columbus, O., will build a new factory.

C. L. Draper has let the contract for a planing mill in Granite City, Ill.

The Southern Co-operative Stove Company, of Rome, Ga., has decided to double its capacity.

The Oneida Knitting Company, De Pere, Wis., will erect a factory building, 45x120 feet.

Ground has been broken for a factory for the Lincoln (N. J.) Water-Proof Cloth Company.

The Kokomo (Ind.) Brass Works have been partly destroyed by fire. The machinery was ruined.

The plant of the Modern Manufacturing Rubber Company at Trenton, N. J., has been burned.

Roland Starr will erect at Toledo, O., a plant for the manufacture of polished maple flooring.

The Clark Caster Company, Plainville, Conn., is preparing to erect an addition to its factory.

Palmer Bros., manufacturers of electrical supplies, are enlarging their factory at North Mianus, Conn.

M. Grolimund has bought a lot at Fergus Falls, Minn., and may place his fanning mill factory thereon.

Contracts have been let for an addition to the tube plant of the Reading Iron Company, Reading, Pa.

The Sandusky (O.) Automobile Manufacturing Company has taken out a permit for a new factory building.

The permit has been issued for an office building for Trump Brothers Machine Company, Wilmington, Del.

The Fox Furnace Company, Elyria, O., will double the capacity of its shops and manufacture new lines of goods.

The contract has been let to build a 67x600-foot hammer shop at Burnham, Pa., for the Standard Steel Works.

There is being erected a factory building, 82x164 feet, six stories, in Cleveland, O., for the American Can Company.

Work is about to be begun on a new building to be occupied by the Conn Band Instrument Company, Marion, Ind.

An addition is about to be built to the factory of Clark Brothers & Co., manufacturers of bolts, etc., in Millidale, Conn.

At the American iron and steel works of Jones & Laughlins, Ltd., Pittsburgh, Pa., a new Bessemer converter will be installed.

Frazer & Jones Company, manufacturer of saddlery hardware, Syracuse, N. Y., has been granted a permit for a foundry building, 44x85 feet.

The power-house and stables of the Victoria Coal & Coke Company, at Caperton, on New River, W. Va., are reported to have been burned.

Contracts for the erection of the new factory and offices of the Consolidated Safety Pin Company, of Bloomfield, N. J., have been awarded.

The Goodhue Milling Company has been organized at Goodhue, Minn., with capital stock of $15,000. Buildings will be erected and equipped.

Additions are to be built to the bolt and section departments of D. M. Osborne & Co., manufacturers of harvesting machines, Syracuse, N. Y.

The Sandusky (O.) Foundry Company, succeeding the Co-operative Foundry & Machine Company, states that it will build extensions to the plant.

A three-story building, 48x50 feet, is to be added to the plant of the Mueller Manufacturing Company, water and gas specialties, Decatur, Ill.

The contract has been awarded for a new factory building for the Amstutz-Osborn Company, mechanical and electrical engineers, Cleveland, O.

It is the intention of the Brown-Corliss Engine Company to erect a foundry at Corliss, Minn., to work in connection with its engine plant.

The London (Ont.) Fence Machine Company, Ltd., will move to Cleveland, O. A building, 108x120 feet, three stories, is about to be erected there.

The Federal Refining Company has plans for an enlargement of its sugar refinery at Yonkers, N. Y., from a capacity of 400 to 3,600 barrels a day.

Permits have been issued for the erection of the new plant for the Union Petroleum Company, manufacturer of petroleum products, Philadelphia, Pa.

The contract has been awarded for a new forge building and blacksmith shop for the Tindel-Morris Company, manufacturer of steel forgings, Chester, Pa.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Stamping Dies. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book, "Dies and Diemaking." 100 6x9

pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

F. L. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Castings and blueprints, 5 sizes boat and sta. 2-cycle gasoline engines; also completed engines; tested, successful. Hildreth Motor Co., Lansing, Mich.

Wanted—Double acting shell punching press, with or without automatic feed; give size and condition and lowest cash price. Address Box 54, AMERICAN MACHINIST.

Book for Machinists.—"A Handbook for Apprenticed Machinists," is also useful to journeymen; price 50 cents. Oscar J. Beale, Providence, R. I., Box 181.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears, catalog of small tools free. R. M. Clough, Tolland, Ct.

Mechanical engineer and draftsman wishes to submit to parties interested in gas and oil engines an entirely new and simple design. Address "Unique," care AMER. MACH.

Drafting, by the job or hour; contracts made for regular work; ideas perfected; all mechanical drawing done quickly and accurately. B. & K., care AMERICAN MACHINIST.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

For Sale at a Bargain—An established manufacturing business, suitable for any first-class machine shop; easily moved; will sell for less than cost of finished stock and throw in patterns, tools and material worth as much more; worth investigating. A., care AMERICAN MACHINIST.

Foundry for Sale.—Complete plant, in Syracuse, N. Y.; will make castings up to 30,000 lbs.; is adapted for general work; has traveling crane, two cupolas, blower, flasks, etc., and is ready to run; plenty of local work; low price and reasonable terms; also have large machine and boiler shops, same place. Wm. A. Reade & Co., 410 American Trust Bldg., Cleveland, Ohio.

For Sale—The best small manufacturing plant in the Chicago district, consisting of foundry, machine and wood-working shops, well equipped with over 40 machines; well lighted brick buildings and plenty of land; 9 miles from city limits; 6 railroads; business established 10 years; good water; cheap fare; no labor unions; is worth $10,000; will take a good deal less; will take Chicago real estate for part pay; best of reasons for selling. Address at once, B. B. Potter, Griffith, Ind.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Practical draftsman wishes position. Box 49, AMERICAN MACHINIST.

For help, write The New York Engineering Agency, 35 Warren st., N. Y. No charge to employer.

Mechanical draftsman, 34, good experience, desires position. Address "C. N.," 231 E. 32d St., New York City.

Experienced pattern foreman on medium heavy machinery desires position. Box 44, AMERICAN MACHINIST.

Skilled mechanic and expert draftsman, a professional inventor, wants engagement. Box 22, AMERICAN MACHINIST.

Competent mechanical draftsman with practical shop experience desires position. Box 8, AMERICAN MACHINIST.

Mechanical draftsman, graduated, with experience, also shop experience, desires position. Box 48, AMERICAN MACHINIST.

Engineer wants position as superintendent of shop or superintendent on erection of machinery. Box 40, AMERICAN MACHINIST.

Situation wanted by a first-class tool dresser and steel worker; a good smith on light forgings. Box 35, AMER. MACHINIST.

General foreman (age 33) for the best of machine shop work; will be pleased to hear from you if in want of same. Box 33, A. M.

Draftsman; 13 years' practical experience (6 years in shop) on general and automatic machinery; tools, jigs and fixtures. Box 41, AMERICAN MACHINIST.

Position as traveling man; 30 years old; have 12 years' shop experience; would like to represent a machinery house. Box 38, AMERICAN MACHINIST.

A competent, progressive and energetic machine shop foreman wants to make a change; small to medium work preferred. Box 57, AMERICAN MACHINIST.

Mechanical draftsman (graduate of foreign technical school) desires position; marine or stationary engine work preferred. Box 60, AMERICAN MACHINIST.

Superintendent or foreman, by practical machinist; 30 years old; has had charge for years; medium or light work; references. Box 39, AMERICAN MACHINIST.

Foreman machinist, good handler of help, hustler, with extensive experience of labor-saving methods and systems, open for position. Box 58, AMERICAN MACHINIST.

Superintendent of small shop, successful in handling men, experienced designer machine tools and special machinery, open for engagement. Address Box 885, AMER. MACHINIST.

Mechanical man, large acquaintance, desires to represent good machinery line in Chicago; engine hoisting, transmission and conveying machinery or tools. Box 37, AM. M.

Have had varied experience as foreman and general superintendent of machine shops; wish to make a change; have done estimating on work for some time. Box 46, AM. MACH.

Mechanical engineer, with 3 years' shop, 6 years' board and 2 years' business experience, holding position as assistant chief engineer in electric automobile works, seeks change. Box 36, AMERICAN MACHINIST.

Designer of special machinery, tools and fixtures for manufacturing purposes, cold working sheet metal, etc., wants a Western position; an experienced and reliable man. Box 45, AMERICAN MACHINIST.

An energetic young man, theoretically and practically educated in the machine business, 5 years' experience, desires position as salesman or draftsman. Address "Willing Salesman," care AMERICAN MACHINIST.

By live, up-to-date toolmaker in northern Pacific coast country; can give good reference as to ability to handle toolroom to advantage in plants producing medium and heavy work. Box 10, AMER. MACHINIST.

Position with progressive firm as assistant to manager, engineer or superintendent, by first-class mechanical draftsman with experience in all departments of shop or varied lines of work. C. H., 257 17th St., Milwaukee, Wis.

A practical machinist of experience in the shop on different classes of work and tools and outside erecting work is open for an engagement and prefers outside erecting work; can furnish the best of reference as to character and ability. Box 50, AMER. MACH.

Mechanical engineer and draftsman wishes to change; technical education; large experience as foreman, master mechanic and superintendent manufacturing small and medium interchangeable machinery and fine steel instruments. Box 4, AMERICAN MACHINIST.

Situation wanted, as superintendent preferred, by a young man who is accustomed to holding position of highest mechanical and business responsibilities; a practical expert, without superior, in developing and designing the highest class of both heavy and light machinery; 10 years in present place. Box 47, AMERICAN MACHINIST.

Managing engineer and commercial man, corporation business over million yearly, desires change; have excellent executive ability; wide experience; familiar with shop order systems and cost accounts; great head for following up detail; expert designer; a pusher; can keep peace among employees; correspondence solicited. Box 52, AMER. MACH.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACH.

Position desired as superintendent by man of 40, with nearly 20 years' experience at the bench, as draftsman, foreman and superintendent, on fine grade of work; successful designer of machines, tools and fixtures; thoroughly familiar with modern shop methods and accounts; excellent testimonials; New York or vicinity preferred. Address Box 34, AMERICAN MACHINIST.

Young married man, now with large Milwaukee concern, wishes change as leading draftsman, assistant superintendent or in office; have 10 years' good experience, general machinery, high speed and Corliss engines; interested services given for future position; Middle or Eastern location preferred; references and particulars given. Address Box 59, AMERICAN MACHINIST.

Help Wanted.

Wanted—First-class patternmakers at once; no labor trouble. Reeves Engine Co., Trenton, N. J.

Die-sinkers wanted, accustomed to drop-forged work. The Kilborn & Bishop Co., New Haven, Conn.

Mechanical draftsman, familiar with passenger and freight elevator work. Box 42, AMERICAN MACHINIST.

Mechanical and structural draftsmen; experienced technical graduates preferred. Box 71, Station B, Cleveland, Ohio.

Wanted—First-class, all-round machinists; steady work and good wages to good men. Reeves Engine Co., Trenton, N. J.

Wanted—Non-union molders; good wages and steady employment. Address Ridgway Dynamo & Engine Company, Ridgway, Pa.

For positions, send stamp to the New York Engineering Agency, 35 Warren st., N. Y., for registration blank. Rates to machinists.

Wanted—Draftsman on boiler and machinery; young man preferred. Address National Water Tube Boiler Co., New Brunswick, N. J.

Wanted—A first-class automatic screw machine hand; one familiar with Cleveland machine preferred. Address R. L. C., care A. M.

Machinists, send for free blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—Two first-class machinists accustomed to jobbing work. Apply by letter only, giving references, Frank Rittinhouse, Norristown, Pa.

Wanted—A first-class designing draftsman; one familiar in designing special machinery. Address Abendroth & Root Mfg. Co., Newburgh, N. Y.

Wanted—Chief draftsmen, to send for a trial sample set of parallel ruler attachments; no expense; circulars to others. Wm. Pilton, Hamilton, Ohio.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—Mechanical draftsman, patternmaker and toolmaker; new shop; 60 hours per week; state experience, age and wages. Columbus Iron Works Co., Columbus, Ga.

Wanted—An experienced mechanical draftsman; one familiar with light work, such as typewriter. To a first-class man a good position is open. Box 53, AMER. MACHINIST.

Wanted—Three patternmakers, accustomed to engine work; six machinists; best wages and steady work guaranteed; references required. Apply Box 875, AMER. MACHINIST.

Wanted—Patternmaker on wood patterns for machinery, competent to act as head patternmaker and foreman; permanent position to right party. Box 888, AMER. MACHINIST.

Wanted—Experienced man as foreman, shop working on reproduction duplicate brass and steel parts; must be good man and thoroughly capable. Address M. F., care AM. MACH.

Wanted—Good armature winders and brass finishers; steady employment and good wages to first-class hands. Apply to Canadian General Electric Co., 8 Queen st., Montreal, Que.

Two machinists, accustomed to working on steam engines; Corliss or Buckeye engines preferred; also millwright; none but steady men need apply. Hartford Engine Works, Hartford, Conn.

Wanted—Machinist and toolmaker, good fitter and scraper; one accustomed to good class work; high wages and steady work; state where previously employed. Box 55, AMERICAN MACHINIST.

Master mechanic wanted; thoroughly familiar with mining and electrical machinery; write fully, stating age, experience, names of former employers and salary expected. Address Box 51, AMERICAN MACHINIST.

Wanted—Man for the position of general foreman of a large manufacturing plant; must be first-class mechanic and be able to handle men; write, giving references. Henry C. Cryder, Marion, Jersey City, N. J.

Wanted—Three first-class toolmakers on small jigs and fixtures for interchangeable work; factory in St. Louis, fine surround-

ings; highest wages paid to good men; transportation paid. Address Box 7, AM. MACH.

Wanted—Experienced toolmaker; one who has had experience on brass work and rapid reproduction of duplicate parts, and is capable to act as foreman of shop employing 20 to 30 men. Address H. C., care AM. MACH.

Wanted—Four good machinists for work on weaving and general machinery; steady, light work; good wages; 50 miles from Chicago. Address promptly, with particulars, Western Cane Seating Co., Michigan City, Ind.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—Toolmaker and machinist; one who is a good scraper and fitter on fine class machine and tool work; also one on watch lathe work; extra good pay and steady work in Greater New York; must give references as to ability. Box 56, AMER. MACHINIST.

Help Wanted.—Machine shop foreman in manufactory of engines and threshing machinery; must be experienced, acquainted with modern methods and of good executive ability; in answering give references, experience and salary expected. Box 3, AM. M.

Wanted—Mechanical draftsman, experienced on stoker, boiler, boiler settings and general engineering work; resident Chicago preferred; state age, references and salary expected. The Under Feed Stoker Co. of America, 837-42 Marquette Building, Chicago.

Wanted—Experienced machine shop foreman by shop employing about 50 machinists; mill and water wheel work; must be first-class mechanic and capable of handling men to best advantage; permanent position; state age, experience and references. Box 26, A. M.

Wanted—A foundry foreman; must be used to a great variety of work in green, dry sand and loam; must be intelligent and steady, able to mix metals and handle men; the right man would find this a steady and attractive opening; references required. Apply Box 874, AMERICAN MACHINIST.

Toolmaker wanted to take charge of toolroom in Pittsburg district; must be acquainted with gear cutting, milling and all tool work in connection therewith; must be willing to operate several machines if requird; good opening for young, energetic man. Address, stating wages expected, to Box 43, AM. M.

Wanted—Two or three good boilermakers and sheet iron workers, to make tanks, smokestacks, blast pipes, coal chutes and general work in this line; steady work and good wages in a first-class, modern shop in Western Pennsylvania, will be given to the right man. Address, stating age and experience, Box 877, AMERICAN MACHINIST.

Wanted—Foreman polisher, by a medium heavy machine tool concern employing 250 men; located 150 miles from Chicago; splendid shop in city of 25,000 people; a man who is a good, hard worker, who can take charge and can also keep busy himself; only a married man of ambition and who is looking for a permanent position need apply. Address Box 9, AMERICAN MACHINIST.

Wanted—By a large and well-established company, west of Ohio, manufacturing high-grade electrical and other machinery, a man in the sales department at the works office, to assist in the preparation of catalogs and other advertising matter, data for salesmen, etc., and correspondence regarding electrical machinery; none but men with experience in the lines indicated will be considered; replies will be treated confidentially. Address, stating experience and salary expected, "Electric," care AMERICAN MACHINIST.

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Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Keystone Mch. Tool Wks., Philadelphia, Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Bulldozers
National Mchry Co., Tiffin, O.
Williams, White & Co., Moline, Ill.

Carborundum
See Grinding Wheels.

Car Link Machines
National Machy. Co., Tiffin, O.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Miami Brass Wks., Hamilton, O.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Allegheny Fdry. Co., Warren, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Castings, Motor
Giant Motor Co., Elizabeth, N. J.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Uniform Steel Co., Newark, N. J.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Conn.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

Chucks, Drill—*Continued.*
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Cloos, Jacob, Milwaukee, Wis.
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wheaton Mach. Co., Boston, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandergrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., N. Y. City.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Alexander Mfg. Co., J. G., Grand Rapids, Mich.
Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dresser
Dickinson, Thos. L., N. Y. City.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Wks., Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

File and Tool Holder
Bowers, Geo. W., Waltham, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.
Kinsey & Burt Mfg. Co., New York.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Westmacott Co., J. M., Prov., R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, H. G., St. Louis, Mo.
Walcott & Son, Geo. D., Jackson, Mich.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Russell, R. M., Binghamton, N. Y.

Grinders, Disc
Bayldon Mach. & Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Saw
Keystone Mach. Tool Wks., Philadelphia, Pa.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Russell, R. M., Binghamton, N. Y.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Olmsted, L. H., Hasbrouck Heights, N. J.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Buss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Toledo, O.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mch. Co., Pittsburg, Pa.

Handles, Machine Tool
Norwood Mach. & Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Enginering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Maxwell Engr. Co., Rome, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.
Woodman Mfg. Co., R., Boston, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Stm. Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Wallace Supply Co., Chicago, Ill.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
Bayldon Mach. & Tool Co., Jersey City, N. J.
National Mach. Tool Co., Cin., O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Tanite Co., Stroudsburg, Pa.
Walcott & Son, Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Gump & Co., A. W., Dayton, O.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
The Adams Co. Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mch. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co. Philadelphia, Pa.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cans, Pump
Wallace Supply Co., Chicago, Ill.

Oil Cups and Covers
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Paint, Water
Wallace Supply Co., Chicago, Ill.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Marston & Co., J. M., Boston, Mass.
Prentiss Tool & Supply Co., New York.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Ct.
Olmstead & Co., H. B., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Keystone Mach. Tool Wks., Philadelphia, Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Falkenau-Sinclair Co., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting.
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co. T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Phila., Pa.

Sand Mixing Machines
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Keystone Mach. Tool Wks., Philadelphia, Pa.
Marston & Co., J. M., Boston, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Pratt Institute, Brooklyn, N. Y.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Gump & Co., A. W., Dayton, O.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
Amer. Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Manchester, N. H.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers, Vertical Die
Rochester Die Shaper Co., Rochester, N. Y.

Shapers
American Tool Wks. Co., Cin., O.
Blount & Co., J. G., Everett, Mass.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Falkenau-Sinclair Co., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mach. Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Springs
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburg, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
McCrosky & Huber, Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.

Trucks, Shop
Towsley Mfg. Co., John T., Cincinnati, O.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
Amer. Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Baylidon Mach. & Tool Co., Jersey City, N. J.
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Whitewashing Machines
Wallace Supply Co., Chicago, Ill.

Wire-Drawing Machinery
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Electrically Driven Mine Hoist.

The accompanying illustrations show a notable development in electrically operated mine hoisting machinery exhibited at the Düsseldorf Exhibition. The electrical work was done by Siemens & Halske, Incorporated, of Berlin, and the mechanical work by the Fredrich Wilhelmschutte Mining Machinery Corporation, of Mulheim-on-Ruhr. Small electrical hoists are, of course, not uncommon, but so large a machine as this is, so far as we know, unprecedented. At the close of the exhibition the machine will be erected at the Zollern II pit of the Gelsenkirchener Mining Association, Incorporated.

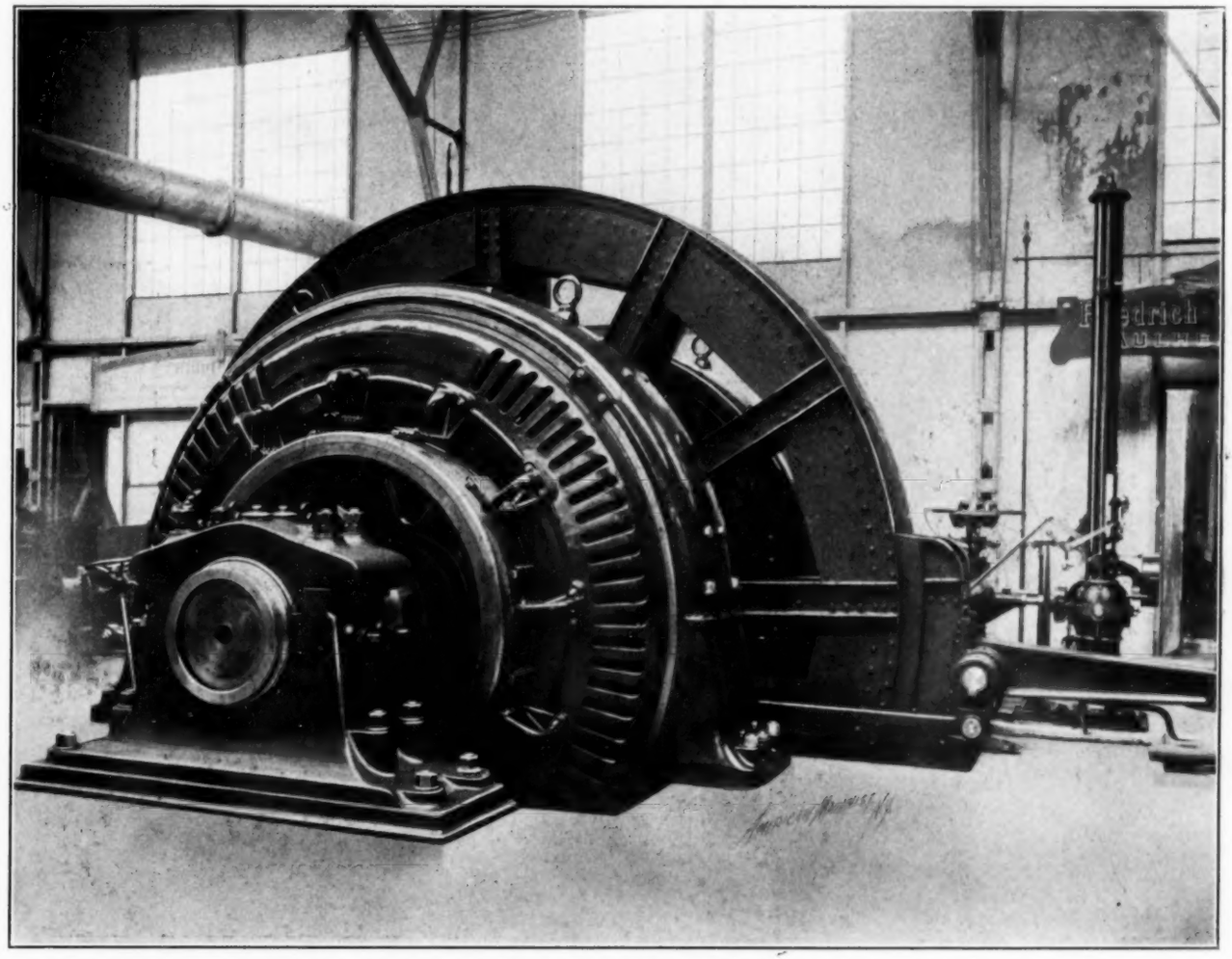


FIG. I. SIDE VIEW OF ELECTRIC MINE HOIST.

The Gelsenkirchener Association already operates a large amount of the machinery of its new plant at the above mentioned pit electrically, and decided in March, 1901, to introduce electrically operated hoisting machines.

The machine illustrated was designed to hoist 4,200 kilograms (9,200 pounds) of coal at each lift from a depth ultimately of 500 meters (1,640 feet), although at the start the depth will be but 280 meters (920 feet). The ultimate hoisting speed will be 20 meters per second (3,936 feet per minute), though at the start the speed will be but half of this. With 16 effective hoisting hours per day and from a depth of 500 meters, the daily capacity with a single unloading platform is 2,700 metric tons (2,975 English short tons). With a double platform the daily capacity rises to 3,200 and with three platforms to 4,000 metric tons respectively.

The appearance of the machine is excellently shown in Figs. 1 and 2, from which it will be seen that a main shaft carries at its center the rope sheave and brake drum, at each side of which is located an electric motor of 1,400 maximum horse-power each. These motors may be connected in series or in parallel, and thus be worked at full or half speed, and in case of accident to one motor work may be continued with the other.

By various combinations of the storage battery and alterations of the field current, speeds of 2, 4, 5, 6, 8, 10, 12, 16 and 20 meters per second can be obtained without loss of energy and, with slight loss from the rheostats, practically any intermediate speed may be obtained. To examine the rope the speed may be reduced to 30 centimeters per second (59 feet per minute).

The order in which the battery cell groups are switched in alternates with each trip. As one cage ascends the battery is discharged from right to left, and as the other ascends it is discharged from left to right. The various groups and cells are thus subjected as nearly as possible to the same conditions.

The rope sheave is described as made on the Koepe system, in which the hoisting rope passes but once around the sheave. We have endeavored to obtain details of this, but have failed. The diameter of this sheave is 6 meters (19 feet 8 inches). The hoist is balanced—that is, a cage is attached to each end of the rope, one of which ascends while the other descends—and to make the balance exact at all positions of the cages a tail rope hangs below them.

The current supplied is continuous, the voltage being 500. A storage battery is provided to meet the very intermittent work and also to enable the voltage to be gradually switched in as the speed increases at starting.

A depth indicator will be observed directly in front of the operator's platform, and connected with it is a Bauman safety device which limits the working speed and insures a gradual reduction of the speed

when landing the load. This device shuts off the current and applies the brake should the speed exceed the desired maximum and, moreover, gradually and automatically switches off the current as the cage approaches the landing platform. Of this device we have been unable to obtain particulars.

Fig. 3 shows a plan and elevation of the machine. At *a* is the indicator and below it at *b* the Bauman safety device. At *c* is the starting resistance, the contact points of which are arranged in a horizontal circle. The vertical axle extends upward through the arched foundation and is turned by a rack and pinion from the pneumatic auxiliary regulating gear *d* in the room above. This gear consists of a working cylinder and a dash-pot cylinder, and works on the differential or floating lever principle, the movement of the piston rod acting to close the valve which the hand lever has opened, the movement of the piston rod following and corresponding exactly with that of the hand-lever. This lever has a right and left as well as a fore and aft motion, the right and left movement determining the direction of motion. When the lever is in the right-hand position the right-hand cage ascends, and when in the left-hand position the left-hand cage ascends.

At the left of the hand lever, in Fig. 2, which controls the motion, and mounted on the same stand, is an additional lever which controls the pneumatic brake, of which the air cylinder is at *e*, Fig. 3. The air compressor is located at *f*. The Bauman safety device acts to put on this brake. As a still further precaution, an emergency gravity screw brake *g* is provided for use in case the air brake should fail. We judge that the detached hand-lever at the left of the main lever stand in Fig. 2 is for tripping this gravity brake, which, as we understand, is applied by a weight which is always suspended ready for action.

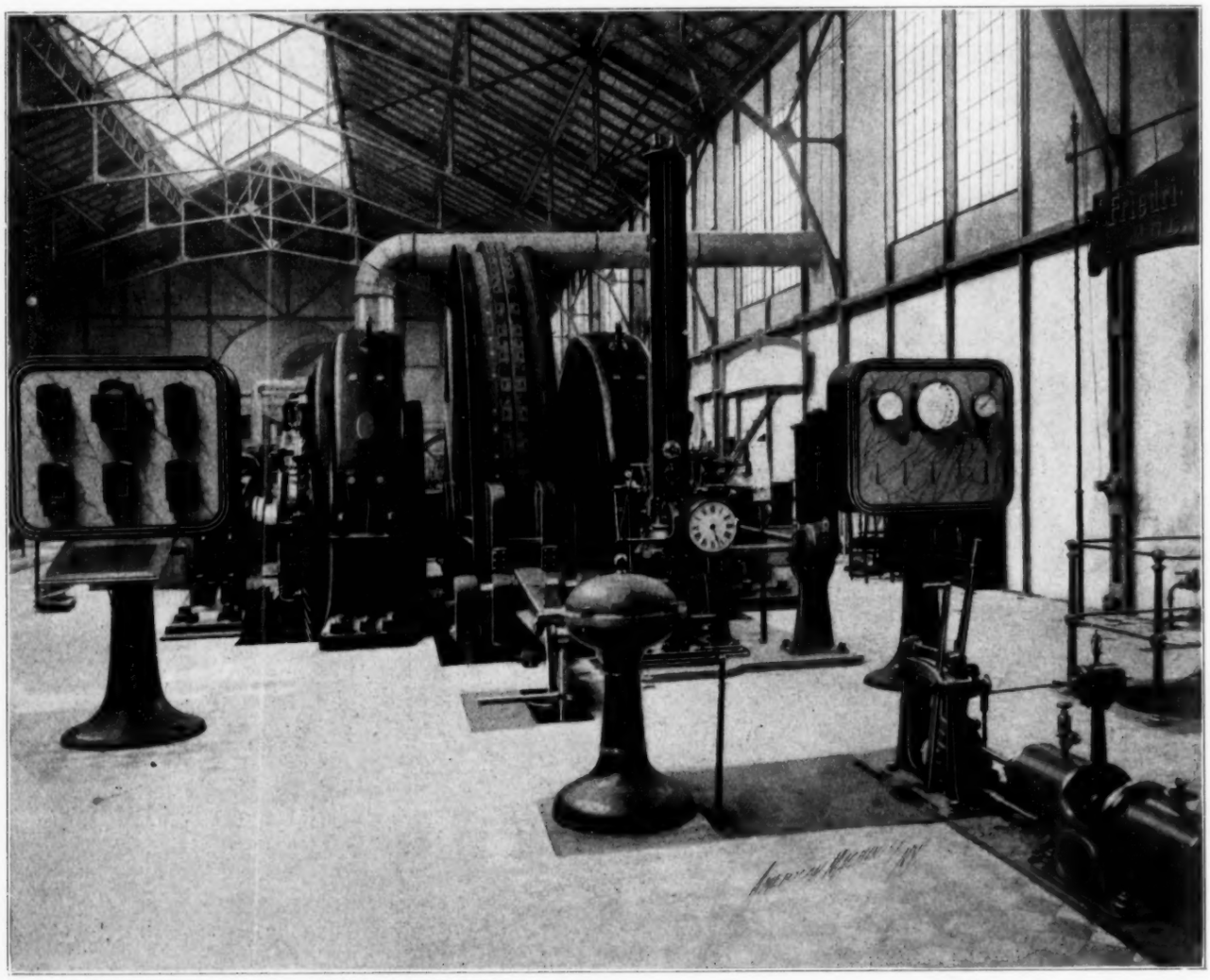


FIG. 2. VIEW OF MINE HOIST FROM THE REAR OF THE OPERATOR'S PLATFORM.

Legal Notes.

LIBEL OF MANUFACTURED PRODUCTS.

An especially interesting decision has been handed down by the New York Court of Appeals in the case of the Marlin Fire Arms Company *versus* Shields. It relates to the degree of immunity one may enjoy in criticising the manufactured goods of another, even in a false and malicious manner. It also involves the question whether constitutionally guaranteed rights ought to be menaced if not positively infringed, through resort to injunctions as a legal expedient; injunctions being—as many laymen have learned in the last few years through the controversies that have arisen over this question in other relations—a form of procedure peculiar to "equity" or "chancery," as distinguished from "common law" jurisprudence, and followed by courts, or sessions of court, which are allowed to sit without a jury.

The plaintiff company was a manufacturer of the Marlin repeating rifles and had withdrawn its advertisement from a magazine called *Recreation*, published by Shields, because the advertising rates had been increased. Thereupon, it was alleged, Shields had set to work to defame the rifle by publishing letters purporting to come from correspondents, but which, the Marlin company claimed, were "fakes," as well as being false in their assertions. These articles discredited the mechanism

and operation of the Marlin rifle, attempted to show that it wore out too soon and tended to throw it into disfavor by comparison with others. The Marlin Company hence prayed for an injunction perpetually restraining the defendant from publishing "any article or statement, in any form or under any guise, falsely attacking, misrepresenting or depreciating plaintiff's said rifle, or its accuracy, effectiveness, merit or value." The injunction was denied and an appeal was taken to the Appellate Division of the Supreme Court, where this decree was reversed. The case has since been carried to the Court of Appeals, which has, by a vote of 5 to 2, reversed the Appellate Division, thus affirming the propriety of denying the injunction. The decision was rendered on an assumption, for the time being, of the truth of the plaintiff's contentions.

When one seeks to obtain an "equitable" form of relief, it is generally necessary to show that those available in common law courts are inadequate. The Marlin Company had attempted to justify its petition for an injunction, instead of depending upon the ordinary legal procedure that might be open to it—viz., suits to recover for damages incurred through the libelous publications—on the ground that if restricted to the latter sort of redress, it might have to bring a multiplicity of suits to recover for future libels, which could be forestalled by the injunction; secondly, it argued that although greatly injured in its business by the publications, it could not determine the extent of damage, so as to afford an adequate common law remedy.

The Court of Appeals holds that, so far as the Marlin Company contended that it had no adequate remedy at common law, it argued justly enough. In order to maintain a regular action on libel in such a case it would have to be able to prove special damage, which according to its own statement it could not do. Had there been a defamation of the Marlin Company itself, as distinguished from its rifles—that is to say, if their faults had been ascribed to fraud, want of skill, or something of that sort on the part of their manufacturer—then, according to the authorities, there might have been cause of action even where special damages could not be proved. But it was otherwise here. And since, therefore, the Marlin Company had no way to maintain an action for damages at all, it could certainly not justly enter into a multiplicity of actions, and its prayer for an injunction by holding out such an alternative was not well founded.

Thus the first of the plaintiff's points is disposed of, and as to the second, Judge

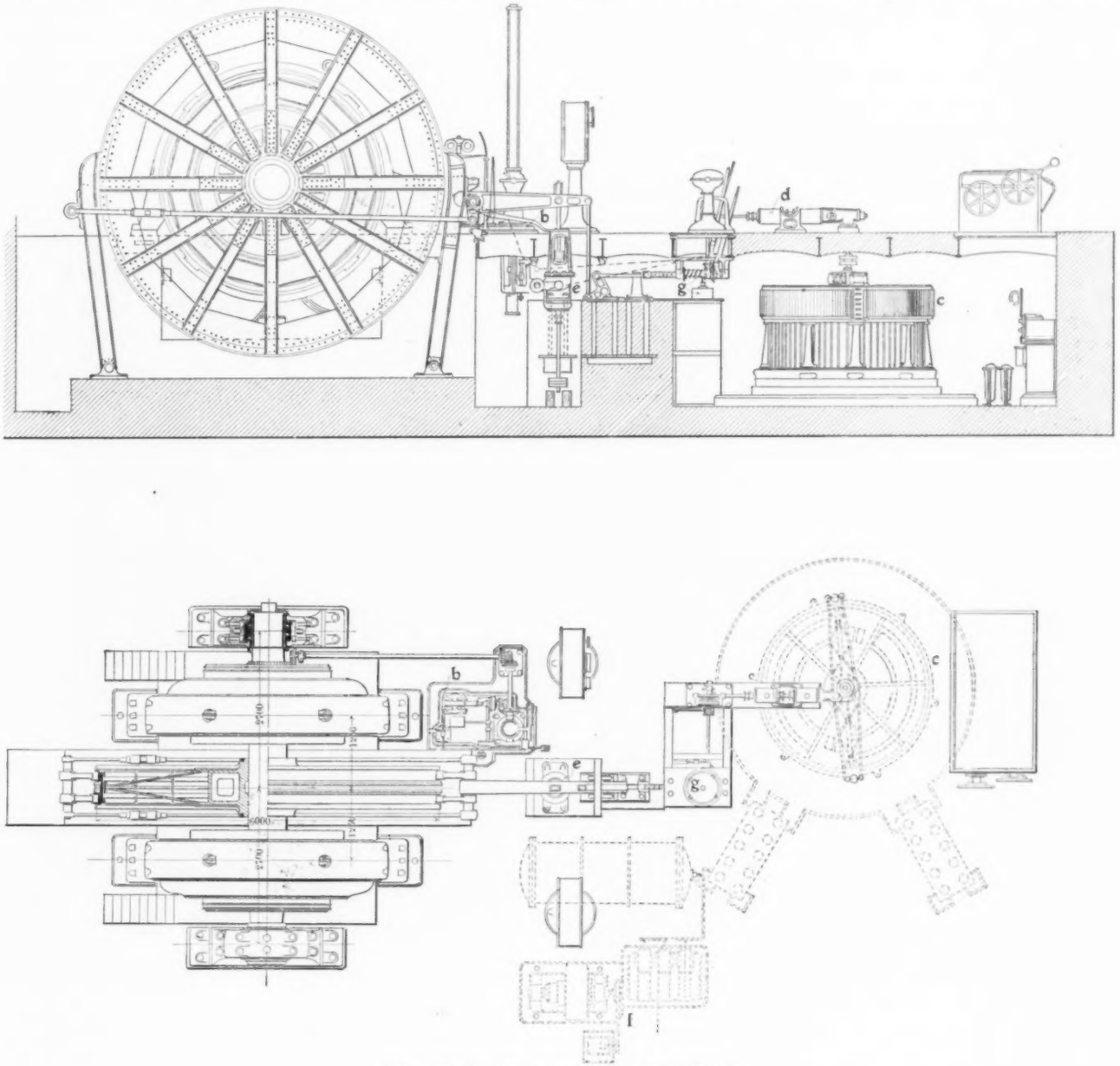


FIG. 3. PLAN AND ELEVATION OF MINE HOIST.

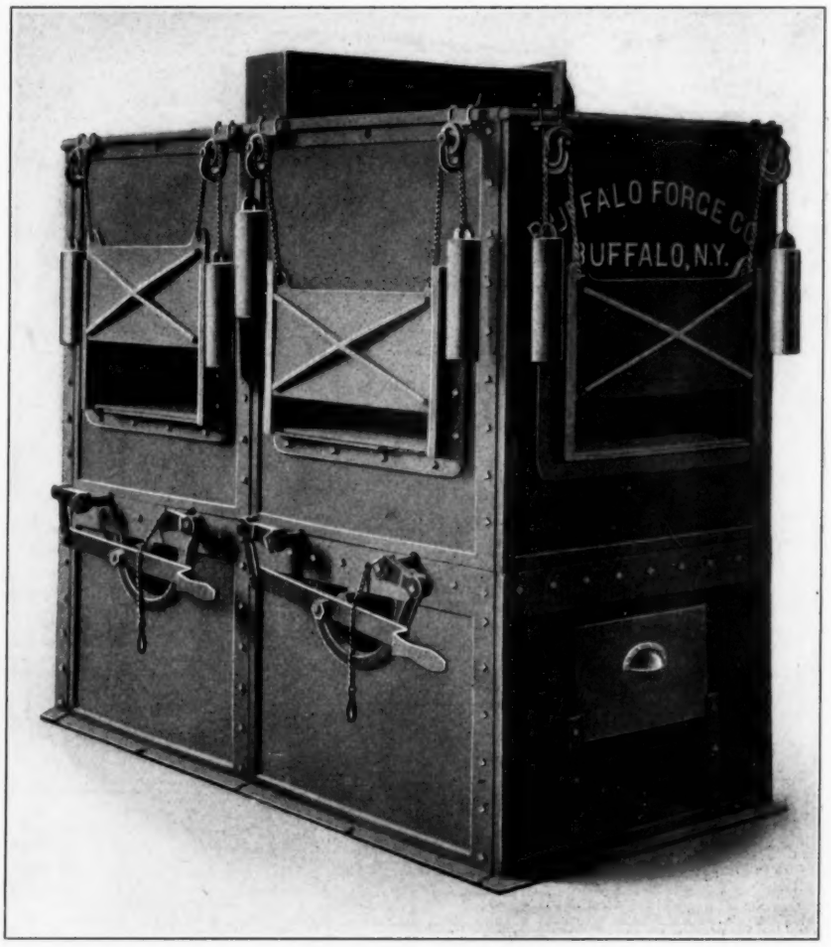
Parker, for the Court of Appeals, continues:

"Another ground of [resort to] equity alleged is, that plaintiff has no adequate remedy at [common] law 'because of the impossibility of ascertaining, identifying or establishing, according to legal principles, any measure of damages.' That he had no adequate remedy at law is true; for, as we have seen from an examination of the authorities, his complaint indicates that he has no remedy at law whatever. This brings us to the real question of the case—whether an unjust and malicious criticism of a manufactured article, for which the manufacturer has no legal remedy at law because of his inability to prove special damage, is the subject of equitable cognizance. The constitutional guarantee of freedom of speech and press, which in terms provides that 'every citizen may freely speak, write and publish his sentiments on all subjects, being responsible for the abuse of that right; and no law shall be passed to restrain or abridge the liberty of speech or of the press' (Const. N. Y. Art. 1, Sec. 8), has for its only limitations the law of slander and libel. Hitherto freedom of speech and of the press could only be interfered with where the speaker or writer offended against the criminal law or where the words amounted to a slander or libel of a person or corporation or their property, and the guaranteed right of trial by jury entitled the parties accused of slander or libel to have twelve men pass upon the question of their liability to respond in damages therefor and to measure such damages. But the precedent which the plaintiff seeks to establish would open the door for a judge sitting in equity to establish a censorship not only over the past and present conduct of a publisher of a magazine or newspaper, but would authorize such judge by decree to lay down a chart for future guidance in so far as a plaintiff's property rights might seem to require, and, in case of the violation of the provisions of such a decree, the usual course and practice of equity would necessarily be invoked, which would authorize the court to determine whether such published articles were contrary to the prohibitions of the decree, and, if found so, punishment as for a contempt might follow. Thus a party could be punished for publishing an article which was not libelous, and that, too, without a trial by jury."

Judge Parker then reviews the authorities to see whether there is sufficient precedent for the interference of an equity court in such a case, with the remark that "if such precedent be not already established by the courts of this State, it is our view that it ought not to be." He fails to find such a precedent laid down.

It cannot but be noticed how closely the circumstances and reasoning found in passages quoted from Judge Parker's opinion are applicable to other matters concerning which the propriety of injunctions by courts of equity has been a live topic of discussion for several years past.

It is also to be observed that in New York State—where a large proportion of the periodicals of the country are printed—a door seems to be flung open to the publication with comparative impunity of malicious libels on manufacturers' products by unscrupulous journals. Publishers of the highest class will of course continue to take great pains to exclude from their columns all unfair and uncalled for defamations, not only those which are intentional, but—within the limitations of an always fallible human nature—those which are accidental. Their motive in so doing must henceforth be ascribed to something other than fear of legal consequences. They must expect, moreover, always to find, as in the past, manufacturers who will take offence at their refusal to eulogize one machine or commodity by the defamation of some other.



A DOWN-DRAFT FORGE FURNACE.

A Down-Draft Forge Furnace.

We give herewith an illustration of a forge furnace adapted particularly for heating work in connection with steam hammer or similar heavy forging.

A new idea has been introduced in building this forge in sections. Two of these sections are shown in the engraving. In this way the capacity may very easily be increased at any time by installing additional sections. The first or original section is 30 inches long, and each additional section adds 36 inches to the length of the forge, making 66 inches the usual length. Each section is furnished with balanced slide doors on all four sides. When these doors are opened, access may be had to any part of the forge without the least trouble.

The hight from the floor to the top of the grate is 36 inches—the door sills in turn being set slightly above the grate, which is of the improved rocker-grate type 24x66 inches. In the cut the lever attachment for rocking the grate and removing the ashes, and the chain connected to the air box are shown.

The Buffalo down-draft principle of smoke removal is incorporated in this forge. In the illustration, the stationary exhaust hood is shown at the top of the forge. It carries away all smoke and exhaust gases, allowing none to escape into the shop. The smoke and gases are immediately and completely withdrawn by down-draft suction through underground tile pipe, there being no escape from even the heaviest fires. This does away with all overhead galvanized-iron piping, which

is subject to frequent renewal and always obstructs valuable light and space.

A clean-out door is placed at the bottom of each section, allowing of easy access below the grates. The forge is completely lined with fire-brick, and in the roof there is an additional strip of asbestos. The weight of the forge alone, *i. e.*, two sections without the brick lining, is 5,000 pounds.

The British Navy.

Americans are prone to believe that we have some pretty good "kickers" here, and as a matter of fact we have, but their efforts in that line are ridiculously poor, and puny compared to what your vigorous and robustious Britisher can do when he puts his mind—or is it his legs?—to it. The following is a report of the latest performance in that line that has come to our notice. It is a special cable dispatch to the Chicago *Record-Herald:*

"Sir William Allan, M. P., does not allow the fact that he was given his title but a few months ago to restrict his criticisms of the government. This week he made a sweeping indictment of His Majesty's navy and its management. The necessity for the possession of sea power, he said, included steam power, gun power and man power, yet the British navy possessed none of these. The 'Terrible' which was designed for 22 knots, had crawled home from China at 9 knots, and the dockyards were so congested with crippled cruisers that vessels had to be sent to private yards for repairs. When the 'Powerful' came home from China the repair bill amounted to £80,000 or £90,000.

"He contrasted these vessels with the Bavarian transport steamer, which had traveled 250,000 miles, carrying safely 80,000 men, and had never needed to be laid up for repairs.

"As to gun power, the newest vessels were inferior in the weight of metal fired to American and Japanese vessels of similar displacement. In regard to manning, the British fleet was a phantom fleet with a skeleton crew. The navy needed immediately 14,000 firemen, 2,000 engine-room artificers and 900 engineers. 'When all the vessels had been dispatched for the coronation naval review,' he said, 'there were only two firemen left in the whole naval reserve.'

"'Why,' he asked, 'are there not sufficient engineers and firemen on board the men-of-war? Because the navy is still run on old conservative and traditional lines—a navy for aristocrats, where practical engineers are excluded from officers' rank. If the admiralty would build, arm and man ships as they ought to it could be done for half the money it is now costing. The admiralty is a gigantic muddle.'"

It will be perceived after a time that only absolute monarchies, wherein the people have little to say, can maintain large and efficient armies and navies.

Machine Tools and Mechanical Exhibits at the Dusseldorf Exposition.

BY FRANK C. PERKINS.

The mechanical exhibits at the Düsseldorf Exposition are of a very fine character, and a few of them are illustrated herewith.

In the Machinery Hall a large proportion of the machinery is operated by electric motors, and Figs. 1 and 2 illustrate two machines constructed by the Kalker Werkzeugmaschinen Fabrik, Breuer Schumacher & Co., Actien Gesellschaft, of Kalk, near Cologne, on the Rhine.

The first is a 60-inch slotting machine with screw motion driven by a direct current multipolar motor. The machine was designed for the heaviest forge work and is provided with movable vertically adjustable guides for the cutter bar.

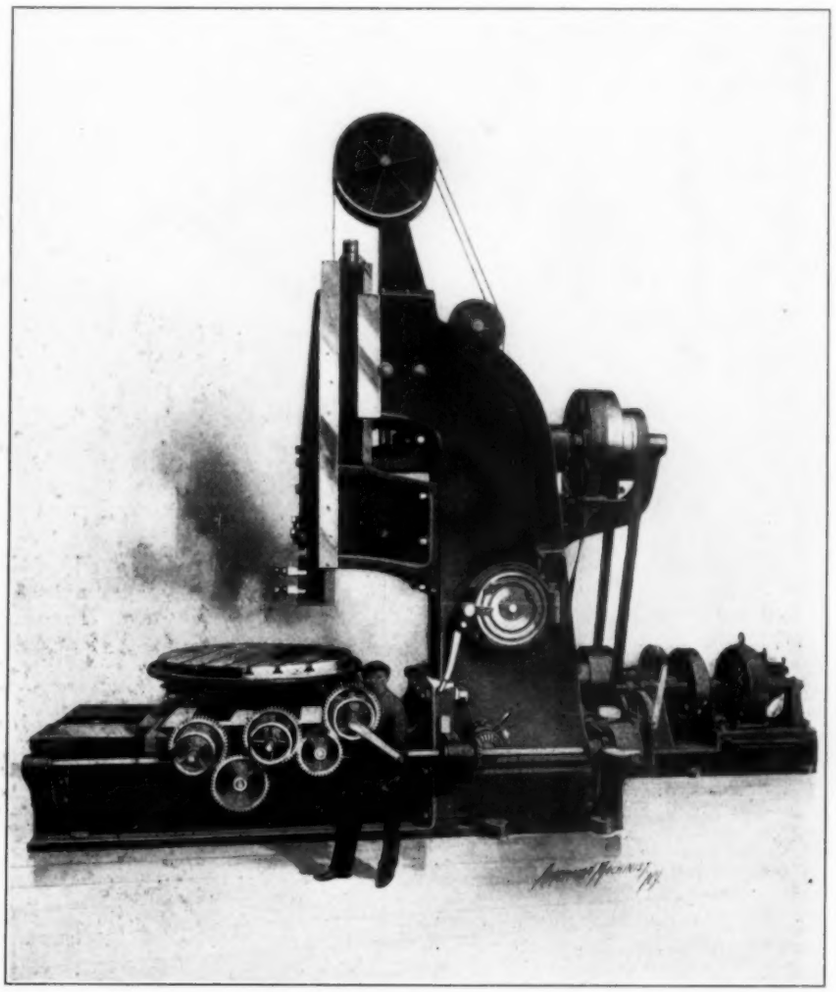


FIG. 1. KALKER WERKZEUGMASCHINEN FABRIK ELECTRICALLY DRIVEN SCREW SLOTTING MACHINE.

The cutting stroke is just half as quick as the return stroke and the cutter bar is counterbalanced by weights.

The two pins, which effect the reversing motion of the cutter bar, are fixed upon a disk, and the stroke of the cutter bar can be readily adjusted by the scale upon the disk, which is arranged at a convenient hight.

The vertical adjustment of the bar guide is made by hand, and in the highest position of the bar the work can be slotted with a depth up to 2,100 mm. The planed round table is slotted, has a diameter of 1,700 mm. and a longitudinal and transverse adjustment of 1,500 mm. The feed is effected by ratchet wheels and the table has also a rapid power movement in either direction.

The machine is driven by an electric motor situated at the rear, giving the motion through gearing, open and crossed belts and bevel gear to the screw spindle.

Between the slotting machine and the electric motor a quick acting clutch and brake are arranged. At starting, the electric motor can be disconnected until it attains its full speed, and in the case of accidents the tool may be stopped at once.

The screw spindle is of Siemens-Martin steel and supported in bronze bearings, of which the upper one is a ring cam bearing for taking up the longitudinal pressure. The ring cam bearing also is assisted by a counter pressure pin [whatever that may mean].

The high-speed shafts run in bronze bushings, and the working gears are of

steel, the pinions being of phosphor bronze, while all gears are milled or planed.

An electrically driven beam shearing machine exhibited by this firm is shown in Fig. 2. It consists of a hydraulic shear, of which the two-throw pump is driven by a 10 horse-power electric motor. The frame of the machine consists of two cast-steel standards which enclose the steel hydraulic cylinder above the plunger having leather packing [cup leathers?]. The upper shear blade is attached to the shear blade holder on the plunger and has a guide just above the work.

The return motion of the upper shear blade is effected by a small drawback cylinder above the pressure cylinder. At the side of the shear the two-throw pump is mounted. When starting, the pump works at first with two pistons, and the idle stroke and the punching of holes is quickly done. As soon as the material offers a certain resistance to the shear blades, one pump piston is thrown out of gear and the other piston works alone with a suitable higher pressure.

One of the most interesting buildings is that known as "Krupphalle." It is constructed to represent a huge battleship, and is located near the entrance to the Exposition Grounds on the bank of the River Rhine.

The total length of the hall is 134 meters with a total breadth of 35 meters, while the length of the ship construction is 110 meters with a breadth of 26 meters. The hight of this construction is 18.5 meters, and the total floor space is 4,280 square meters. The exhibits on the interior are of the most interesting character, showing the products of the great Krupp Works, including army and navy materials, battleship armor, cannon, mortars, and everything going to make up the equipment of a great modern cruiser.

The electrical exhibits include electric motors for operating the great guns, handling ammunition and operating the electric searchlights. Arc and incandescent electric lighting for cabins, engine-rooms and other parts of great warships, as well as the details of illumination of the great Krupp Works, are shown. Enormous steel castings are shown which are used as field frames for electric generators, and an electrically operated crane shows the methods of handling great weights at the extensive Krupp plant.

At these works the electric motors in use number 369, while for lighting the works 1,960 arc lamps and 9,740 incandescent lamps are required, which are supplied with current from three central power stations and seven sub-stations. The electrical transmission lines for this great manufacturing plant include 28.7 kilometers of underground cables and 42 kilometers of overhead lines.

The steam engineering exhibits at the Krupp Hall include a fine showing of marine steam boilers, steam pumps, steam and electrically driven ventilating apparatus, and high-power, triple-expansion and compound engines for driving torpedo boats, and torpedo boat destroyers.

An enormous engine shaft is shown along one side of the hall which was constructed for the "Kaiser Wilhelm II." This fine shaft is 46 meters long and, with the propeller shaft, will measure 70 meters in length, and the total weight will not fall short of 226 tons.

A great marine boiler plate hanging along one side of the hall above the long shaft is 26.8 meters in length, 3.65 meters wide, 38.5 millimeters thick, and weighs 29,500 kilograms.

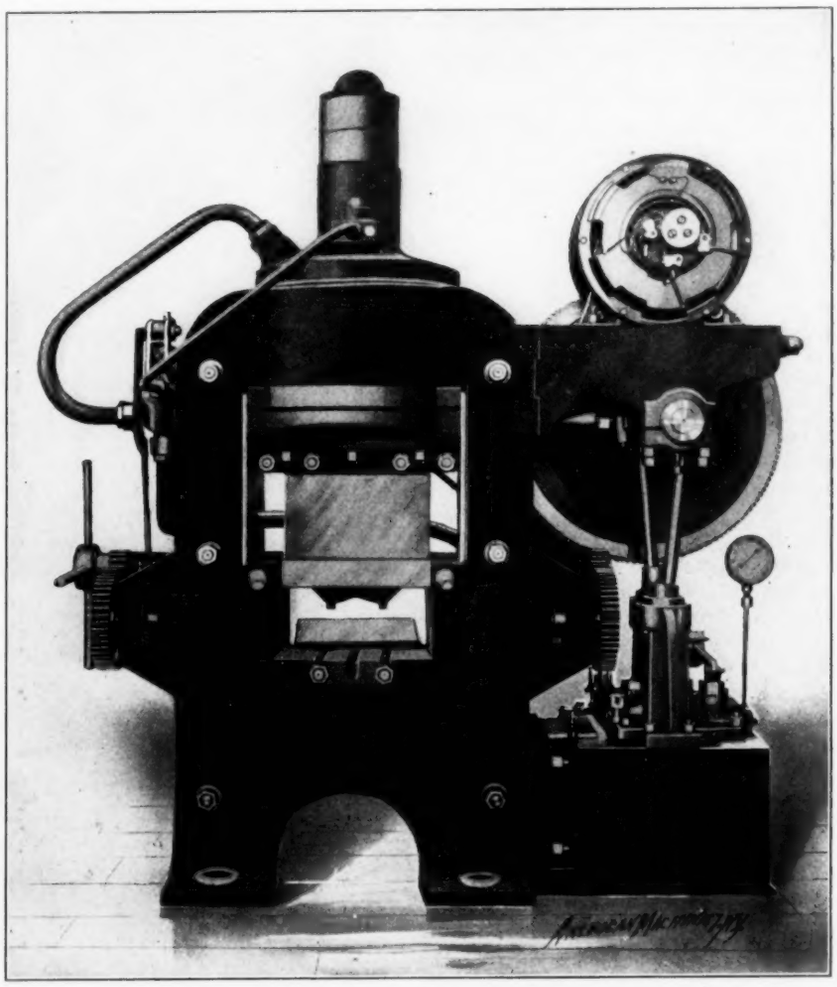


FIG. 2. KALKER WERKZEUGMASCHINEN FABRIK ELECTRO-HYDRAULIC BEAM SHEARING MACHINE.

Magnificent illustrations are exhibited of the fine warships equipped by the firm of Fried. Krupp, including that of the Russian Kreuzer I. Kl. "Askold," as well as the interiors of the officers' rooms, supplied with the latest electrical equipment in the way of fans and lights.

Most interesting views are shown of the workingmen's homes (Fig. 4) at the various Krupp works, which numbered, January 1, 1902, 5,469 dwellings. The firm of Fried. Krupp has done wonderful things for its workmen.

Among the important marine exhibits at Krupp Hall is an enormous armor plate (Fig. 5) located just outside the main entrance and weighing 106 tons. This nickel-steel plate is 13.16 meters long, 3.4 meters high and 30 centimeters thick.

In addition to the fine showing of army guns and gun carriages, there are several ship's cannon ranging in sizes from a bore of 15, 19 and 21 to 28 and even 30.5 centimeters in diameter. There is also a very fine exhibit of armor piercing shells and portions of some of the largest ships under construction, including some of the largest steel bow, stern and rudder frames and posts (Fig. 6) for ocean liners.

Peter Friederick Krupp, the founder of these great works, was born in 1787, and the works were established in 1810. He died in 1826, his son, Alfred Krupp, being then 14 years old. The works grew to immense proportions and at his death, July 14, 1887, was celebrated throughout the world.

The number of workmen employed at the smallest plant at Buckau is 2,773, and at Kiel 3,887, this number increasing at each of the various plants, until at Essen the number of workmen employed exceeds 34,500 men. The total number of workmen in the employ of this firm exceed 43,000, who represent families numbering 147,645 persons.

In the year 1900 the total amount of money distributed by this firm for sick benefits, family physicians, workmen's and officers' pensions amounted to 3,393,855.13 marks, an enormous sum for work of this character.

[We cannot do otherwise than comment, as we have done before, on the superb character of the photographs which come to us from Germany. Our photographers need waking up. The exhibits speak for themselves.—Ed.]

Success in Long-Distance Power Transmission.

The following extracts from a recent lecture by Dr. F. A. C. Perrine is interesting as showing that electrical engineering is like all other engineering—an exact science, when the conditions are known, but that they seldom are known. It has been well said that "engineering begins where rules leave off." Real engineering consists of the application of trained and educated judgment, and not of the substitution of known quantities in cut and dried formulas. Dr. Perrine's lecture begins thus:

"Two elements make success in the long-distance electrical transmission of power—continuity and regulation.

"Perhaps these are the most important elements in any electrical undertaking and are the most obvious, but in attaining our ideal in long-distance work, there lurk pitfalls about these two elements unknown in other fields of the art.

"From the outset in the original studies, and down the line to the last switch and insulation, lie unknown problems and problems known, but unsolved. It is the field of the thoughtful, independent engineer; the ground is stony and fit traveling only to the most resourceful.

"Hydraulic development is one of the oldest arts, but the amount of human ignorance concerning hydraulic problems and conditions is appalling. Records may have been kept of the rivers whose waters are navigable, or whose rapids and falls are along the railroad lines, or in the manufacturing villages; but an investigation of the records available concerning important powers, even a few miles out of the regular lines of travel, would surprise you by their lack of accuracy and detail. Rainfall has been kept for generations for the benefit of agriculturalists, but the watershed of no one power stream of my acquaintance has ever been completely covered in its essential details by rainfall records.

"The water available at any one point where the rainfall can be approximated will be estimated by different engineers from 15 per cent. to 70 per cent. of the total fall, and, apparently, each will be justified by engineering precedents. Such possible variations call for the exercise of caution, judgment and experience in reaching conclusions.

"Nor is there less uncertainty in regard to hydraulic construction. The present year has seen the failure of dams built by engineers of the highest reputation and at water pressures for which they were supposed safe. The flow in canals, ditches, flues and pipes is still subjects of dispute, and errors in design are continually leading to serious results for the investor.

"The one lesson to be drawn from all this is that, if continuity only means suc-

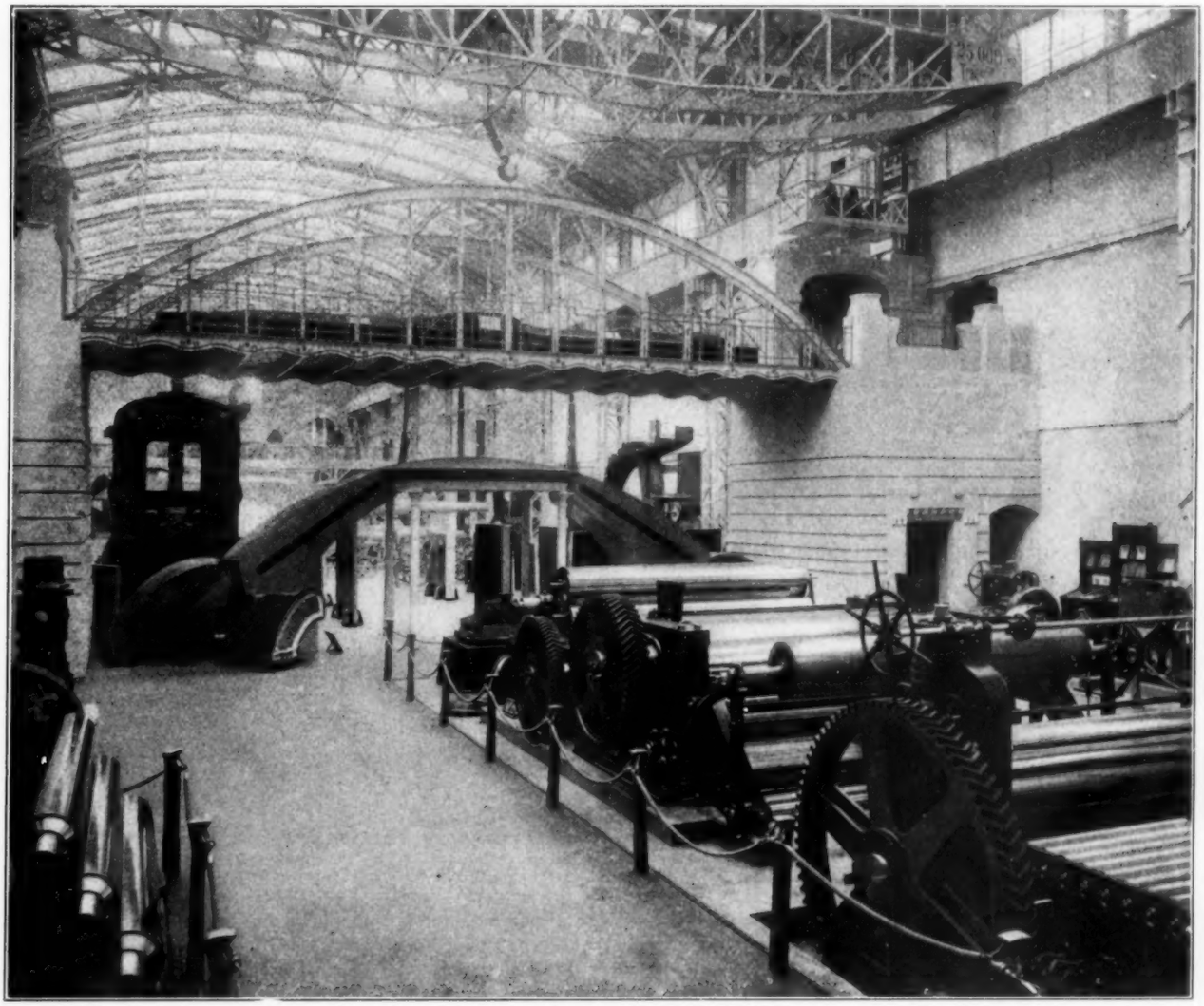


FIG. 3. 2,500-KILOGRAM ELECTRIC TRAVELING CRANE AND ROLL EXHIBIT AT KRUPP HALL.

cess, the studies in water-power location must be made with unusual care, and ample, though never ridiculous, margins allowed in the estimates.

"Perhaps the day may come when the civil engineers will establish their empirical equation in hydraulics on a sure basis, but until that day is reached, and it is not near, the hydraulic engineer can never cease to be a student and most careful observer. In almost all cases the formulas of engineering have a sound experimental foundation, but the error has actually been made of attempting to apply results obtained from the gagings of the Mississippi to sn all, rapid rivers, and even in some cases to lined canals and timber flumes, and an equal error committed of attempting to apply the results obtained from the flow of water in 8 and 10-inch pipes to great conduits and even open flumes. No smile should arise over the absurdity of these errors, for every State in the Union has instances of them, and no year in the past twenty but has seen them committed, to the waste of thousands and hundreds of thousands of dollars. The records for the past five years at one of our most respected testing flumes are at fault on account of an altered pressure pipe and an uncorrected formula. Success comes to the cultured engineer who keeps close to his borrowed data and who solves for himself the unforeseen problems.

"I mean by 'culture' what Matthew Arnold means when he says that culture is 'a pursuit of our total perfection by means of getting to know, on all the matters which most concern us, the best which has been thought and said in the world.'

"Such an engineer with such an ideal will be a safe guide and his studies will establish on a firm basis our transmission undertaking.

"But we are not concerned to-night with the errors of the civil engineer, or with his unsolved problems, so much as with what is new and with what is gradually getting to be known in electrical problems. While these are no more important nor more interesting than the hydraulic problems, they are attracting more attention, and perhaps it is in apology for our electrical ignorance that I call attention to hydraulic difficulties and ignorance. It is true that in no other art can so accurate calculations be made as in electrical engineering, but there are many facts and constants for our equations still unknown. Even in the electrical art there is still an unknown, and I suppose that no one of us will live to see the discovery of even all the knowable our art contains. I am reminded now of the beautiful equation for the dynamo machine presented twenty years ago by Clausius, which contained a round dozen of unknown constants, and though we have since discovered the values of some of his constants, others have been found to have been variables, and we are still studying the problem and searching for the others.

"Regulation in direct work is a simple problem. Its laws are all known; at every lamp it is quite easy to predict the variation of voltage. The same laws control whether the lines be long or short. In his transmission plants Thury has met no new difficulties but has effected regulation at ten or twenty miles, just as he would have done had the delivery been made only in the next room to his dynamos. Resistance is always resistance and his dynamo characteristics remain unaltered by its increase. He deals only with current, voltage and resistance and encounters problems simple even to Faraday, Henry or Ohm.

"It has been said very truly that the introduction of the alternating current raised the electrician above the rank of the artisan. With these currents he is no longer dealing with a few simple independent qualities connected by a primary rule, but must now consider many new elements, some constants and some variables. At every step capacities and self-inductions enter into the solution in complex and involved relations. Regulation can no longer be simply determined for each part of the system independently, and the regulation of the whole obtained by a consideration of the parts separately. Self-inductions and capacities affect each other,

FIG. 4. WORKMEN'S HOMES AT THE FRIED. KRUPP WORKS.

and the generators and lines, as well as the transformers and motors, must be chosen or designed with this interdependent relation in view. A simple case illustrates this beautifully.

"When the operation of the transmission supplying current to the city of Stockton, Cal., from the power plant at Mokelumne Hill, forty-six miles away, was first begun, a curious state of affairs was observed. In operation of the lines alone, the current required on the 2,200-volt side of the step-up transformers was 60 amperes; with the step-down transformers connected, the current fell to about 50 amperes, and when a 100-kilowatt motor was put into operation the current was only 55 amperes. The transmission was designed to be at 25,000 volts, but at the delivery end of the line the voltage was found to be 27,200 volts, and finally the motors consumed full current when running at no load and not much more when operating with full load applied.

"I think that all will agree that here are problems enough for one small instance of the difficulties in the regulation of a long-distance transmission plant."

Facts Regarding the Early History of the Typewriter.

We extract the following information regarding the early history of typewriters from the Census Bulletin on that topic:

"The idea of a mechanical letter writer seems to have first occurred to an Englishman, for the earliest record of a patent for such a device is of one granted by the English Government to Henry Mill, in 1714. . . The theories of the inventor were so far in advance of the mechanical skill of his time, that the machine was never perfected, and it was not until well along in the nineteenth century that any actual progress was made. In 1833, a Frenchman, Xavier Progrin, of Marseilles, was granted a patent by his government for a machine which the inventor claimed would print 'almost as rapidly as one could write with an ordinary pen.' While the modest claims of the inventor were to an extent realized, the machine proved too slow and cumbersome to be of any practical value.

"While many patents have been granted in Europe for writing machines, the real history of the typewriter belongs to the United States; it was in this country that the first practical typewriter was made, and from the very beginning the superiority of the American machine has been recognized in all parts of the world. Therefore the history of the evolution of the practical typewriter of to-day may be gleaned from an account of the failures and successes of American inventors.

. . . . . .

"The first typewriter invented in the United States, called the 'typographer,' was patented in 1829 by William Austin Burt, of Detroit, Mich., also the inventor of the solar compass. This machine was a primitive affair, and could be manipulated only slowly. No practical results were accomplished by the Burt machine, and to-day it is known merely as the starting point of a great American industry. In 1843 Charles Thurber, of Worcester, Mass., patented a writing machine which produced good results in every respect except speed. . . Although this machine was a failure because of its lack of speed, it embodied some of the principles involved in the construction of the modern typewriter.

"Another step in the evolution of the present-day typewriter was the invention of A. Ely Beach, of New York, who in 1847 and in 1856 secured patents on a machine involving the system of type-bearing levers arranged in a circle, swinging to-

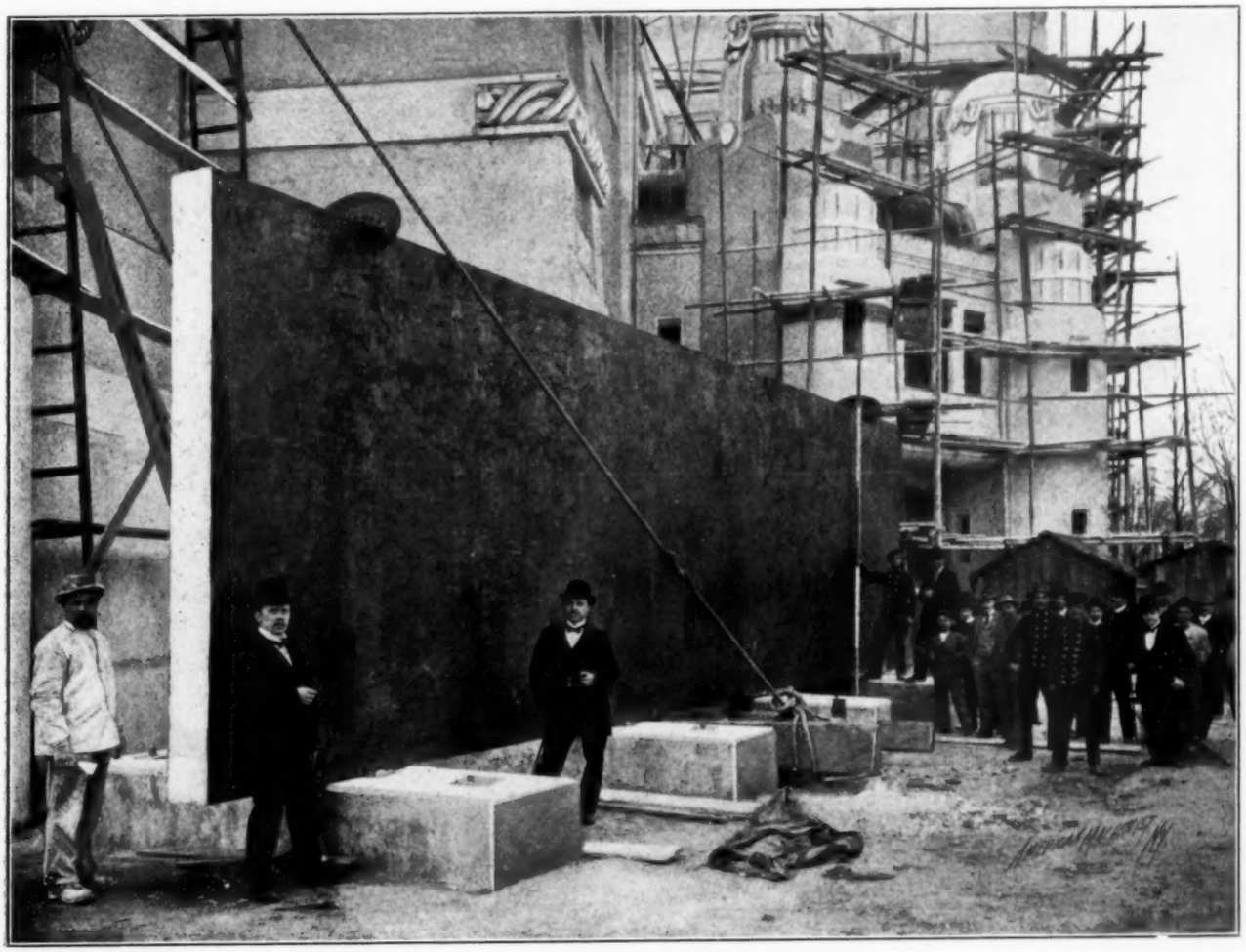


FIG. 5. 106-TON ARMOR PLATE AT KRUPP HALL.

ward and printing at a common center. The inked ribbon, and also the bell indicating the end of the line, were features of this machine, which, although slow in action, embodied principles which have since been successfully utilized and are to-day prominent features of the typewriting machine.

. . . . . .

"In 1868 C. Latham Sholes, Samuel W. Soule, and Carlos Glidden, all of Milwaukee, Wis., were granted a patent on a machine which was a decided improvement over its predecessors. This typewriter embodied an extension of many of the principles involved in former inventions, together with certain features of its own. The inventors continued to make improvements and succeeded in bringing it to a state of practical usefulness, crude though it was when compared with the finished typewriters of the present day. James Densmore became interested in the Sholes patents; he made a contract with E. Remington & Sons, gun manufacturers at Ilion, N. Y., for the manufacture of typewriters on a large scale, and the improved machine has ever since been called the Remington. In 1873, George W. N. Yost, then connected with the Remington factory, was actively engaged in the manufacture of one of the early machines.

"The first person to make a practical business use of the typewriter was Mr. S. N. D. North, of Boston, Mass. This was in 1872, at Utica, N. Y.

. . . . . .

"It was not until 1874 that the typewriter was placed on the market for general sale. Like many other inventions which have grown to be considered indispensable, the typewriter was first greeted by the public with skepticism. But few persons saw the advantages of the typewriter, and during its first few years in the market only a small number were sold. Among the first to recognize the usefulness of the machine were court stenographers, who found that with the aid of the typewriter several copies of the record could be turned out at once with neatness and despatch. Lawyers, having the advantage of the machine thus brought home to them, soon began to adopt it for private use. Courts of law, which for centuries had required all papers to be submitted in handwriting, began to require such papers to be typewritten; and to-day the handwritten legal document is the exception rather than the rule. The large business houses, having an extensive correspondence, being always ready for improvements and time-saving methods, were next to adopt the typewriter, and the commercial world in general soon followed their example. Telegraph companies have made it a part of their equipment, for so rapidly can messages be transcribed that the receiving operator can not only keep pace with the sender, but can maintain speed so great as to bring about the abbreviation of the telegraphic code.

"The use of the typewriter for miscellaneous correspondence became general in all the departments of the Government, except the Department of State, during the early eighties; it was first used for instructions to diplomatic and consular officers of the United States by the Department of State, in April, 1895. The official communications of the Department to diplomatic officers of foreign countries accredited to the United States continued to be handwritten until May, 1897. Ceremonial letters addressed to sovereigns are still handwritten.

"One of the advantages of the use of the typewriting machine over hand labor has been demonstrated in an interesting manner by an investigation by the United States Department of Labor. In this instance, the unit required was the copying

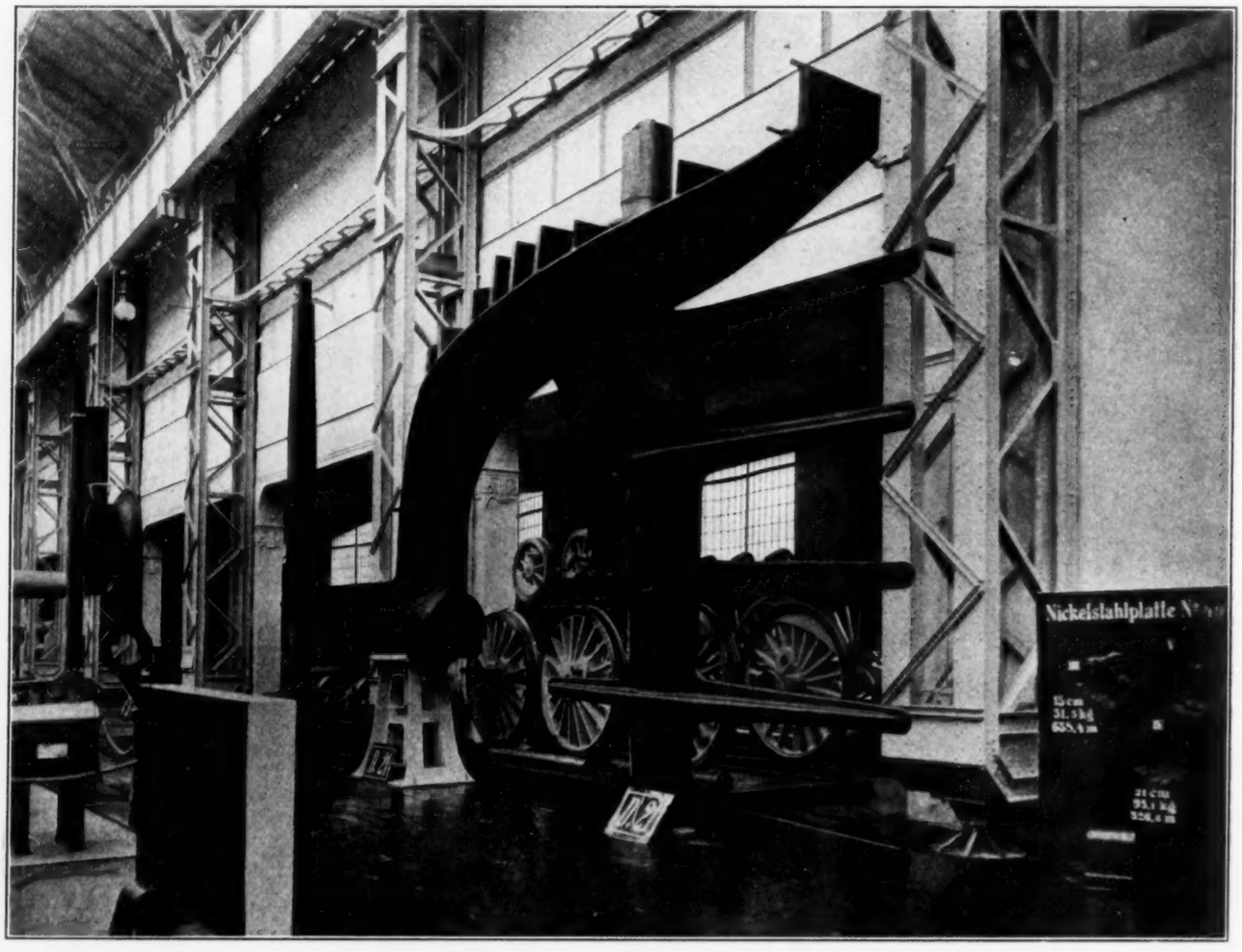


FIG. 6. STERN FRAME AND RUDDER POST AT KRUPP HALL.

of 1,000 words of statute law; this was accomplished by the typewriter in 19.5 minutes, or at the rate of 51 words per minute, while a copyist with a pen required 1 hour and 14.8 minutes, or about four times as long. The quantity of work done by the typewriter depends to a great extent upon the skill of the operator, but it is true also that the proficiency of the copyist enters largely into the quantity of work performed by him. However, it is possible to determine an average, and the figures given may be accepted as a fair and reasonable comparison of the two methods.

. . . . . .

"At the present time inventors are actively at work improving what are known in the art as 'power typewriters.' In this class of machines the operator has merely to touch the key with sufficient force to release latch mechanism, whereupon power from some external source completes the impression."

Strength and Proportion of Keys.

BY FRANK P. KLEINHANS.

Every key in a shaft has a certain torsional moment to resist. This moment may be large or small, but whatever its size, the key should be designed to withstand it. There is many a case where the part to be keyed with a shaft has ample room for a key of the correct proportions; but there are many cases in which one does not have such ample room, and since the gear, or pulley, or whatever the part may be that is to be keyed, must resist a certain torsional moment, it becomes necessary to know what size and what length of key would be necessary to meet the requirements. In case the key should be longer than the part to be keyed, two or more keys should be used. In the calculation which follows, the keys have been made equal in strength to the shaft.

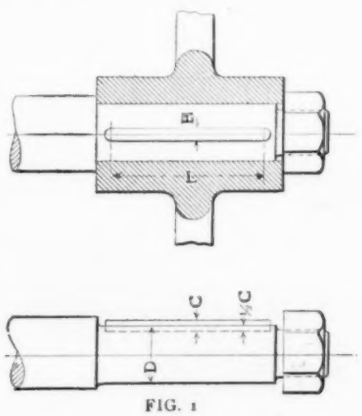


FIG. 1

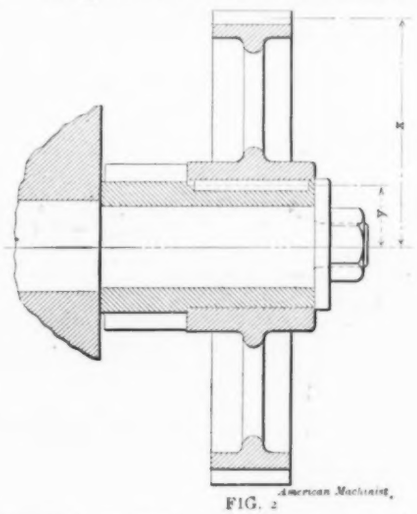


FIG. 2

STRENGTH AND PROPORTIONS OF KEYS.

Let D = the diameter of the shaft in inches,
B = the breadth of the key in inches,
L = the effective length of the key in inches,
T = the twisting moment in inch-pounds,
S_1 = the working stress of the shaft,
S_2 = the working stress of the key.

From the general formula for the twisting moment on shafts, we have:

$$T = \frac{\pi D^3 S_1}{16}$$

This twisting moment must be resisted by the key, which is at a distance $\frac{D}{2}$ from the center of moments. For the key we will have:

$$T = B L S_2 \frac{D}{2}$$

And since the strength of the key is to equal that of the shaft,

$$\frac{\pi D^3 S_1}{16} = \frac{B L S_2 D}{2}$$

$$\pi D^2 S_1 = 8 B L S_2$$

$$L = \frac{\pi D^2 S_1}{8 B S_2} \qquad (A)$$

When the shaft and key are of different materials we can introduce the proper working stresses in equation (A), and by solving we will get the length of key to be equal in strength to the shaft.

The general case is where the shaft and key are of the same material, and then S_1 and S_2 will be equal and (A) becomes:

$$L = \frac{\pi D^2}{8 B} \qquad (B)$$

The length of keys for different shafts have been calculated from this formula, and have been arranged in the form of a table, as shown. These keys as commonly used are made of solid rolled steel, and are placed on the market in lengths of 12 inches.

The size of the keys for the various diameters bears an almost constant ratio to the diameter of the shaft, the width of the key being approximately one-fifth of the diameter.

Referring to Fig. 1, D is the diameter of the shaft where the key is placed—which is apt to vary widely from the diameter elsewhere. L is the effective length of the key, or the distance between the center of the circular ends. C is the thickness of the keys (see table), half of this thickness extending into each part to be keyed. If, in order to get the required length of key, L becomes very great, the key should be made of two or more short pieces, for the reason that it is difficult to make a tight fit of a key that is much longer than seven or eight times its width.

On very heavy shafts, the hub of the pulley or gear cannot be made equal in length to the key, which would be required to transmit the power. In this case two keys would be employed and should be placed about 90 degrees from each other.

Fig. 2 shows another application of a key which should be mentioned. The key, in the case of a shaft, is placed at a distance $\frac{D}{2}$ from the center of the shaft; but here the key is very much farther away from the center, and this means that the key would not have to be so large. In order to meet this case, another column, not yet referred to, has been added to the table. This column shows what torsional moment the different shafts will transmit at a working stress of 10,000 pounds. This column of figures will be found useful in determining what diameter the shaft must be in order to transmit a given torsional moment for the case shown in Fig. 1. It will also be found useful in the solution of the problem shown in Fig. 2.

Suppose that a known force P is acting at the pitch line of the gear at a distance

T = Twisting Moment = The Force × its Arm.

Dia. of Shaft	Keys			T at 10,000 S.	Dia. of Shaft
	Wide	Thick	Long		
¾	3/16	5/32	1.2	830	¾
1	¼	3/16	1.6	1,970	1
1¼	5/16	¼	2.7	6,600	1¼
2	7/16	⅜	3.6	16,000	2
2¼	9/16	7/16	4.3	31,000	2¼
3	⅝	½	5.6	53,000	3
3¼	¾	9/16	6.4	84,000	3¼
4	⅞	⅝	7.1	126,000	4
4¼	⅞	⅝	9.	179,000	4¼
5	1	¾	9.8	246,000	5
5¼	1	¾	11.8	327,000	5¼
6	1⅛	⅞	12.5	425,000	6
6¼	1⅛	⅞	14.6	531,000	6¼
7	1⅜	1	13.9	671,000	7
7¼	1⅜	1	16	829,000	7¼
8	1 10/16	1⅛	16	1,005,000	8

STRENGTH AND PROPORTION OF KEYS.

X from the center, and suppose also that the gear is fastened to a pinion by a key at the distance Y from the center. The pinion runs idle on the stud, as shown. The torsional moment about the center of the gear is:

$$T = Px$$

The length of the key to withstand a torsional moment of 80,000 pounds in a 3½-inch diameter shaft would be $\frac{80,000}{84,000}$ of 6.4 inches. An' since the key is in a larger diameter than the shaft, its length would be diminished inversely as its distance from the center. Placing this in the following expression, we find:

$$L = \frac{80,000}{84,000} \times 6.4 \times \frac{\frac{1}{2}\ D}{y}$$

$$= \frac{80,000 \times 6.4 \times 1\ \frac{3}{4}}{84,000 \times 3\ \frac{1}{2}}$$

$= 3\frac{1}{8}$ inches for the proper length of the key.

For the case of a shaft, say, 3¾ inches diameter, which lies between the sizes given in the table, it will be accurate enough to assume the strength of the key to vary in direct proportion between 3½ inches and 4 inches.

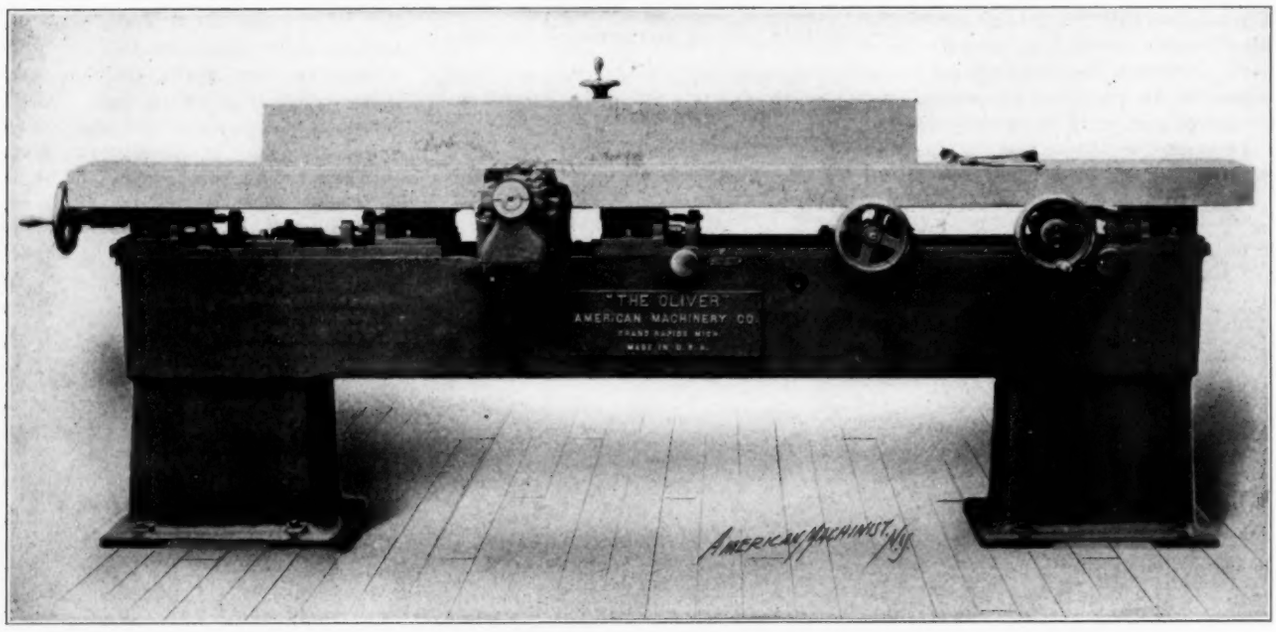


FIG. 1. THE OLIVER HAND JOINTER.

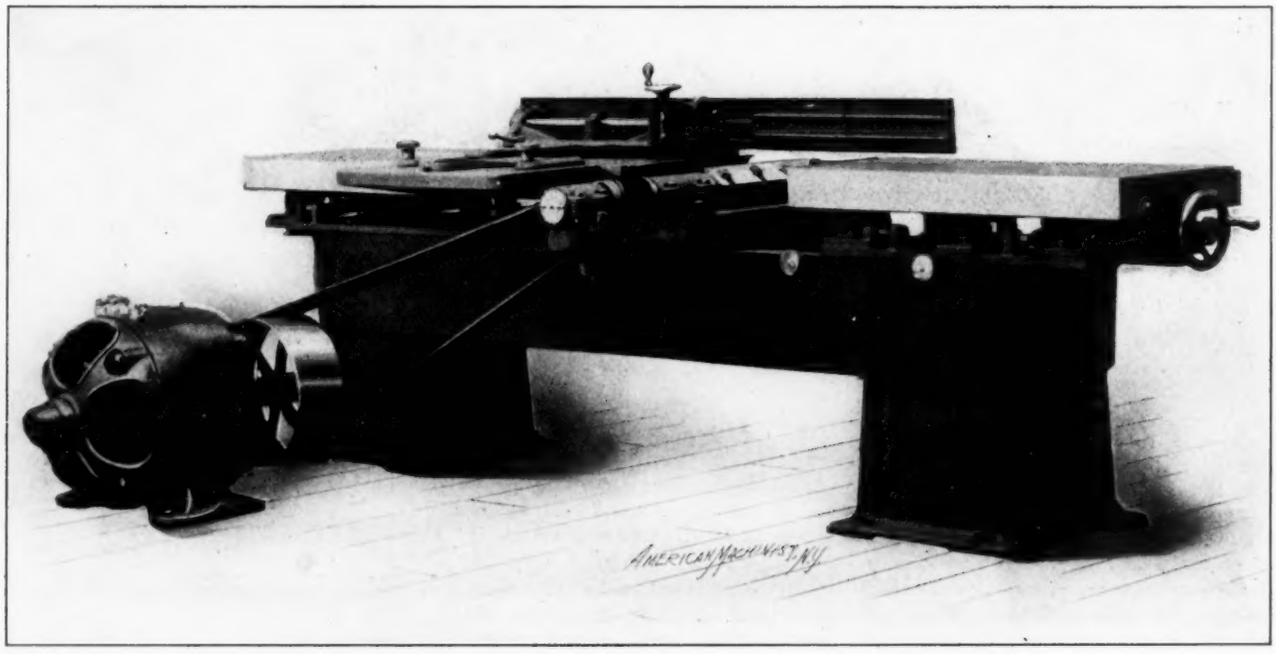


FIG. 2. REAR VIEW JOINTER.

In order to better show the method of finding the size of the key, we will take an actual case:

Suppose $P = 10,000$ pounds,
$X = 8$ inches,
$Y = 3\frac{1}{2}$ inches.

Then $T = P\,X = 10,000 \times 8 = 80,000$.

By referring to the table, we find that the nearest value to T is 84,000, and that the key corresponding to it is ¾ × 9-16 × 6.4 inches long.

The Oliver Hand Jointer.

The illustrations are designed to show the construction of a hand planer and jointer made for use in machinery building establishments whose work requires something better than the ordinary machine. The machine is unusually heavy, the 16-inch machine weighing 2,800 pounds net. The workmanship, we have reason to believe, is of a superior order, and as to the design of the machine our readers can judge as we go along.

Fig. 1 is a front view of the machine, showing it to be supported upon a pedes-

tal at each end. The frame is severely plain, and to the top of it is bolted the yoke or frame which carries the cylinder. This yoke is in one piece, so that it may be removed and taken away entire for repairs or any other purpose.

As usual in such machines, there are two tables which are independently adjustable vertically, and the table at the left (referring to Fig. 1) has beside this vertical adjustment an independent angular adjustment, which is specially adapted for planing pieces with draft, as in pattern work. The method of arranging for this is best shown in Fig. 4, where the table is seen to rest on blocks with transverse circular ways formed in them to which the table is fitted and a projecting arm attached to the lower side of the table engages with a cross-slide which is moved by the hand-wheel *A*, Fig. 3, and thus adjusted to any required position and held. By this construction the table is very solidly supported and held at any angle.

The table is adjusted vertically in the usual manner by means of wedges or inclined planes upon which the table is moved endwise by screws and hand-wheels. The pieces themselves on which the inclined planes are formed are adjusted on the bed, so that by moving them the tables can be accurately alined, and they are tongued and grooved to the table and fitted by scraping, so that when adjusted they will keep in line. The bearings are of genuine babbitt and are oiled with felt running into a reservoir of oil in the yoke. The cylinder is made of crucible machinery steel and is 3½ inches in diameter, carrying two knives, with the other two sides slotted for the use of extra knives of any shape desired. The diameter of the cylinder bearing is 1¾ inches, the two main bearings 8 inches, and the outer bearing 6 inches long. The cylinder has about 3-16 inch end play, which may be taken out by setting the driving pulley against the end of the bearing. This is necessary when special cutters are to be used.

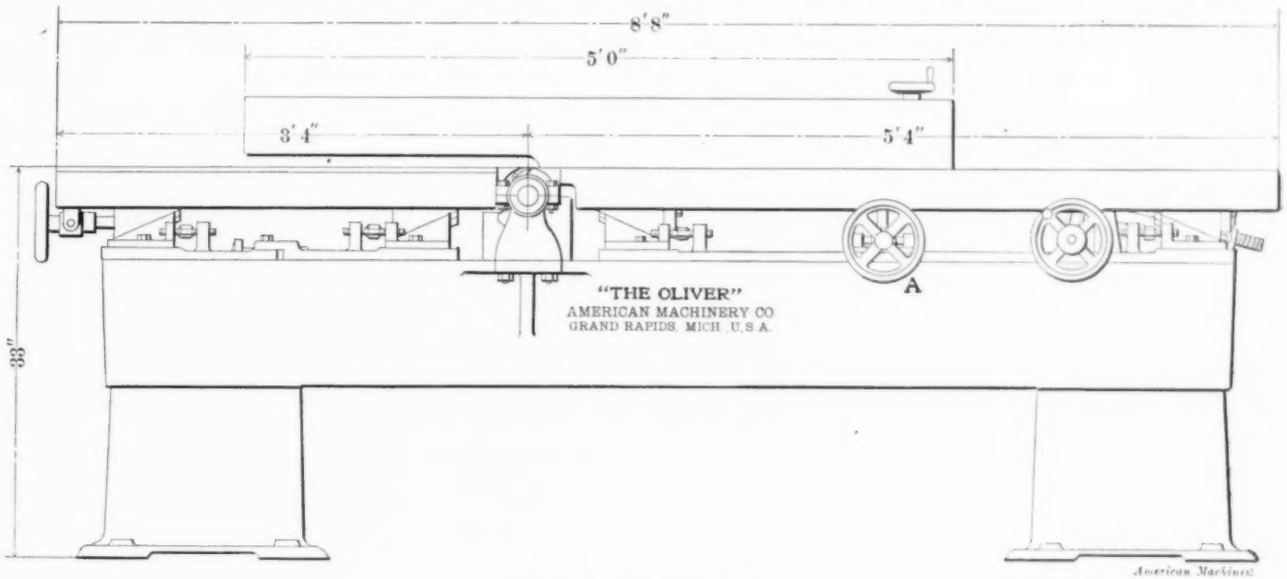


FIG. 3. THE HAND JOINTER.

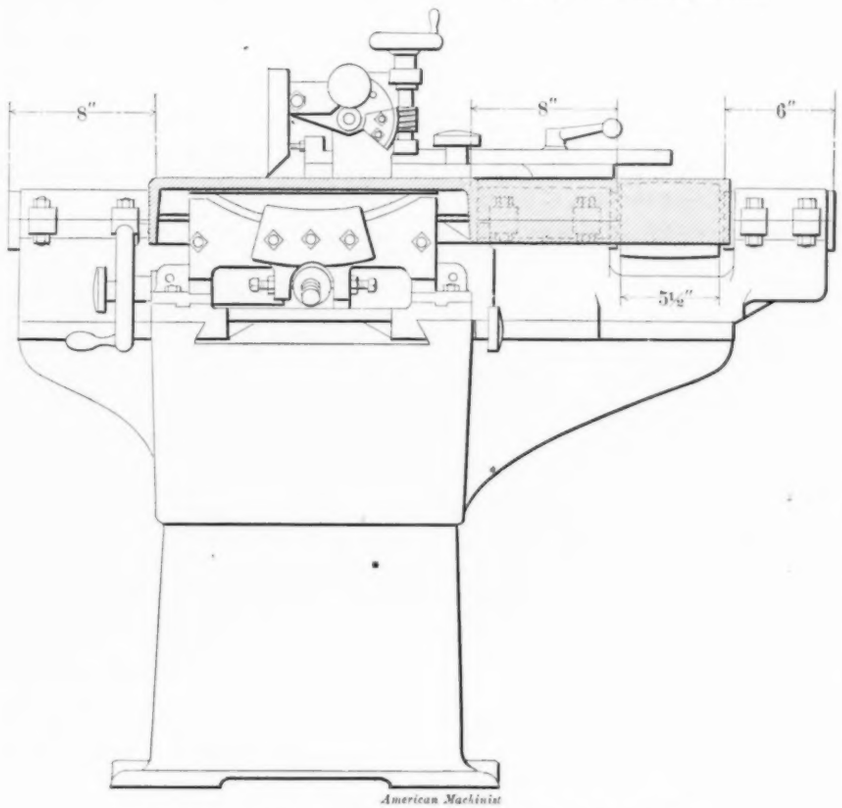


FIG. 4. END VIEW AND PARTIAL SECTION OF HAND JOINTER.

The fence, or gage, consists of a slide which is bolted to the top of the work table, slides backward and forward by simply releasing one hand-nut, and is capable of being used the full width of the table without change. It may also be tilted from a square to 45-degree angle with a worm and worm-wheel, or may be locked at any intermediate point. The fence is 5 feet long and 5 inches wide. When not in use it rests upon the bracket, leaving the full width of the table clear.

Fig. 2, which is a rear view of the machine, shows it arranged for driving by a motor; a countershaft of the regular form is supplied regularly.

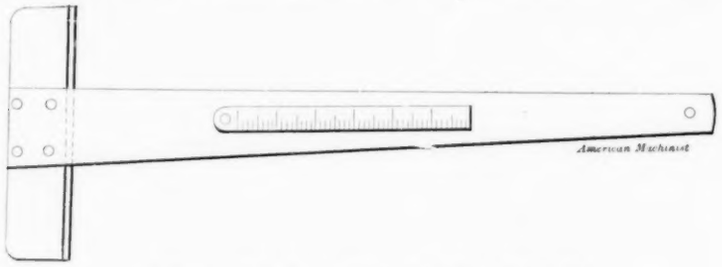
Good progress is being made with the erection of the American Northrop looms recently imported from Hopedale, Mass., by a Hyde firm, and it is expected that over a hundred of them will be started about the 15th inst. Many Lancashire manufacturers are anxious for an opportunity of seeing them at work.—*The Engineer.*

Letters From Practical Men.

Attaching the Drawing Scale to the T-Square.

Editor American Machinist:

I have found it very handy to have a scale attached to the T-square, as shown in sketch. Being firm, it is much handier



A DRAWING SCALE ATTACHED TO THE T-SQUARE.

to set the compass or dividers to. The usual scale often slips, especially on a slanting board, when you have to hold both rule and compass. Of course, I use a separate rule for general use.

Birmingham, Eng. J. C. HAFNER.

Simple Device for Opening a Furnace Damper.

Editor American Machinist:

Anything which relates to the economy of coal cannot fa'l to be of great interest the coming season.

The simple arrangement herewith illustrated will enable the man of the house to dampen the fire in his furnace during the night, thereby saving a considerable amount of coal and yet be able to get up in the morning at a reasonable hour and find the house warm and comfortable.

A 75-cent alarm clock is hung on a hook directly above the weighted end of the lever, a light chain is attached to this end of the lever, and, having a ring at the other end, is carried upward and the ring slipped over the key of the alarm, as shown in Fig. 2. The length of the chain is so adjusted that when the ring is attached to the alarm key the weighted end of the lever *b* is raised sufficiently high for the damper *c* to be entirely closed. The air supplied to the grate is thus shut off and furnace dampened for the night.

The clock is set so that the alarm will go off at the desired time. When the alarm is set in motion, the ring is thrown off the key, the weighted end of the lever *b* falls and the damper *c* is opened, allowing a fresh supply of air to pass through the fire. Then steam is soon raised in the boiler and the house is warmed before the people are up.

If it is not convenient to hang the clock above the furnace, the chain may be passed over a couple of pulleys and brought down to the clock which is fastened firmly to a shelf, as shown in Fig 3. This apparatus need not affect the general working of the dampers at any time after the alarm is off, because the slack chain will allow for the free movement of the lever.

S. B.

Fitting Gas Engine Pistons.

Editor American Machinist:

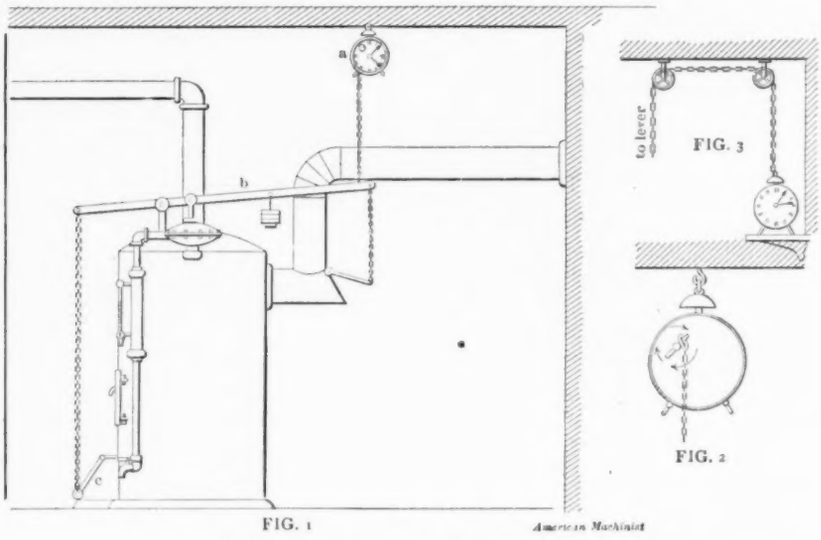
In answer to the inquiry as to the practice of fitting gas engine pistons, I will relate some of my experience in that line. The pistons varied in size from 4 to 14 inches diameter; length equalled about two and one-half diameters. The grooves for rings took up about one-third of the length and that part of the piston was turned about 1-32 inch smaller than the bore of the cylinder to allow for expansion at the rear end, which of course becomes highly heated. The pistons were finished by grinding and were tapered from 2 to 8 thousandths from the front end of the first ring.

The pistons were taken from the grinder and tried in the cylinder at both ends till they would enter not less than three-fourths of their length in the smallest end. In these trials they were pushed with the hand or foot only—no pounding.

We were then ready to file, and after trying the piston at both ends we looked for hard spots to scrape out of the cylinder at the end if it went in easier at the rear end.

Take a float cut file and file the hard spots on the sides of the piston, but do not touch the top or bottom. Use no red lead and keep on filing till the piston can be pushed the entire stroke with the hand. It is now ready to test after the rings are in place. On the testing stand it is given a few preliminary filings and finally the cooling water is shut off and the engine allowed to run till it is so hot you cannot place your hand on the cylinder, but not hot enough to take off the paint. Then the water is turned on full force till it becomes cool, and the piston is removed and hard spots eased off on the rings and the piston; which completes the job.

CHEROOT.



OPENING THE DRAFT ON CHILLY MORNINGS.

The Need of an Index.

Editor American Machinist:

Doubtless many of your readers feel, as I do, that they would like to have the matter you publish, particularly the "Letters from Practical Men" in some "get-at-able" shape. Our memories are not all very long, except for the one particular subject that we happen to be working on at the moment, and we often do our reading when we are pretty tired.

For instance, if I want to make a new blueprint frame, or have a jig to make for a new piece, I would be likely to find at least indirect suggestions of value, if it were not such an impossible task to go over the material indexed weekly or semi-annually. As things are now, it would take so long that it seems foolish to have thought of it.

Any very complete card indexing would be costly and unsatisfactory at the very best. In fact I am writing because I want to state rather than solve the problem.

The best thing that occurs to me would be a semi-annual index, under such heads as Jigs, Templets and Pattern Shop, with subheads of Tools, Methods of Work, etc., Drawings or Drawing Office, Foundry, with subheads, and so on. I am no indexer, and I am not sure the thing can be done at all; but if it can be—and I am inclined to believe it can—it would be invaluable. A mechanical memory is a thing we need in these days if our work is at all varied. A CONSTANT READER.

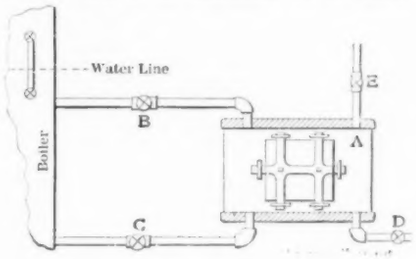
[Our correspondent is not the first one

to experience this difficulty. For the past few years we have paid greatly increased attention to our annual index, which we believe is now the most complete of any published by any technical paper. We do not know of anything more that we can do, but shall be glad to have any ideas which our readers may possess.—Ed.]

A Scheme for Tempering Steel.

Editor American Machinist:

I have been much interested in the articles by Mr. E. R. Markham on the hard-



A SCHEME FOR TEMPERING STEEL.

ening and tempering of steel. At page 1163 he shows conclusively that the temper of steel is drawn quite perceptibly at the temperature of boiling water, 212 degrees. As there is at least 200 degrees difference between this temperature and the lowest that can be shown by the coloring of the steel, there must be in this range temperatures that would be nearer right for particular uses than either that of boiling water or that indicated by the lightest straw color of steel. I would suggest that these temperatures could be utilized practically by heating the articles to be drawn in water heated under pressure, and send sketch indicating one manner of doing this

Have a steam-tight drum *A* with a door large enough to admit the work to be drawn, which door could be clamped shut with fastenings sufficiently strong to stand the pressures to be used. This drum to be connected to a boiler by pipes both of which should be below the water line, and of sufficient capacity to permit a free circulation of water between the boiler and the drum.

With both valves *B* and *C* closed and the water in the drum drained out by pipe and valve *D*, the work could be inserted in the drum and should be laid on a rack to support it away from the bottom so that there would be a free circulation of water around the work. Then, having closed the door and clamped it tight, fill the drum with water by the supply pipe *E*. When the drum is full, with valves *D* and *E* both closed, the valves *B* and *C* can be opened. If the drum was filled with cold water, this would need to be done gradually at first, but as the water in the drum became heated the valves could be opened full and by controlling the pressure of the steam in the boiler the steel articles could be maintained at any temperature within the capacity of the apparatus to stand the required pressures.

Not only could lower temperatures be determined than can be shown by the color test, but they could be secured with much less risk of exceeding the temperature desired and more uniformly throughout the pieces being tested. A. M. Gordon.

Roller Bearings.

Editor American Machinist:

Your correspondent, George L. Roby, at page 1314, takes exception to the saving effected by the use of roller bearings, as stated in a letter recently sent you.

His statement that the "weight of a good wagon is about 1,500 pounds and a load of 2,000 pounds is as much as can be loaded upon a wagon; the axles usually are 3½ inches, rear wheels 48 inches and the front wheels 42 inches in diameter," is not correct. The average horse carries a load greatly in excess of 2,000 pounds, and without difficulty, with an ordinary common axle. An axle 1½ inches in diameter will very readily care for a load of from 2,000 to 3,000 pounds. The axle he specifies (3½ inches) will carry a load of 30,000 pounds, and even heavier, without difficulty. As for the size of the wheels, it is only necessary to write to any wheelmaker to learn that both front and rear wheels range in hight from 2½ to 6 feet or more. A 3½-inch axle, such as he specifies, is very rarely used.

The wagon which was used in making the government test referred to at page 1168 of your paper weighed, including the load, 5,000 pounds. Precisely the same wagon and load were used in making the test with the roller-bearing axles as with the common style. The wagon was of the ordinary army transport type, and both tests were made under as nearly as possible the same conditions.

It is undoubtedly true that formulas to determine the exact amount of power lost by friction are to be found in all mechanical text books, but it does not follow that they are absolutely correct. The use of roller-bearing axles does, without the slightest question, enable the load to be increased from 25 to 50 per cent., and carried with the same ease as the lighter load. In fact, one customer has several wagons fitted with our axles, which he writes he is using in Boston (which city undoubtedly has as bad streets as any), with one horse carrying a load of 9,000 pounds of iron. This he has done for over a year and a half. Very many others could be cited, if desired, showing conclusively that a roller-bearing axle saves much more than would be indicated as being possible by Kent's formula.

We have made a test of roller bearings by mounting a shaft *A* in a phosphor bronze bearing *B*, all parts being very accurately made, and mounting in the same housing *C* upon a separate shaft *D* a roller bearing *E*, both bearings being in split boxes *B G*, so that by putting a pressure by a screw *H* upon one, it is transmitted to both bearings equally. With this device it is possible, by turning the screw *H* by hand, to make the pressure so great that it is impossible to turn the plain bearing by hand, while the roller bearing can still be revolved by turning the handle with apparently no more effort than when but half the pressure is applied. A test of this sort would undoubtedly prove Kent's figures to be absolutely incorrect.

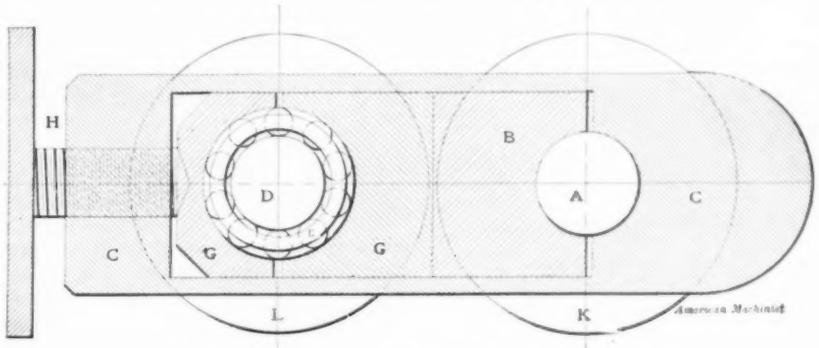
Ball Bearing Company,
By S. S. Eveland.

[We are not disposed to doubt the utility of ball and roller bearings, but we do not think the model illustrated fairly represents a plain bearing. Very few bearings indeed are subjected to pressure from both sides, as is the case in the model. This constant pressure would soon expel the oil, and the scraping of the joints would assist this action. In actual bearings in which there is no slack, as, for instance, lathe and drill press spindle bearings, the fit is still a running fit with allowance for oil.—Ed.]

Sizing Blanks for Drawing.

Editor American Machinist:

I was interested in the methods "Experience" gives at page 1056 for finding the sizes of blanks for stamped cups and the like. Although I cannot believe that there



MODEL FOR TESTING PLAIN AND ROLLER BEARINGS.

are many shops which resort to the "cut and try" method for this, or even the weighing of the sample and then trying for a disk of the same weight, perhaps a word on this subject may be useful if to no other but "Experience" himself.

It is nearly always important to know the exact diameter of the disk required

for a stamping, first because usually a recess is made in the die to center it, and second because material must be ordered so as to be on hand when the dies are ready. Further than this, the form of the disk is, to a great extent, determined by the amount of disk which will project over the edge, and this is of course known only when the diameter is ascertained before designing the dies.

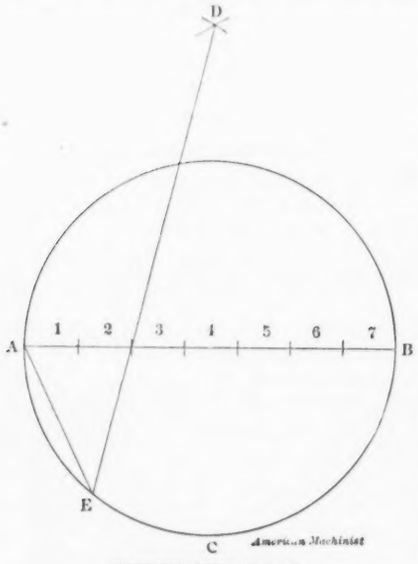
Simple and easy arithmetic gives the desired diameter, as follows: Diameter $= \sqrt{\frac{a+b}{.7854}}$, where a = area of base or solid end of cup, and b = surface of vertical or turned-up part. There can be no question about the correctness or application of this rule, because it simply gives a disk with a surface area equal to that possessed by the cup or stamping desired to be produced. I need hardly say that, in metals of considerable thickness, mean diameters should be taken in ascertaining surface of cup and an allowance made for one-half the thickness of the bottom in taking the hight H. E. BROWN.

Slough, England.

Dividing The Circle.

Editor American Machinist:

Mr. Appleby's solution of the problem of dividing the circle, at page 1275, recalls to mind the discussion which took place in the columns of the AMERICAN MACHINIST about ten years ago on the same subject, in the course of which Mr. Jas. M. Du-



DIVIDING THE CIRCLE.

pries solved the problem in the following manner:

Let $A\,B\,C$ be a circle which we wish to divide into any number of equal parts; draw a diameter $A\,B$, and from A and B with the radius $A\,B$ strike arcs cutting at D. Now divide $A\,B$ into the given number of equal parts, and through the second division point from either end draw the line $D\,E$ cutting the circle at E, then the line (or chord) $A\,E$ is the required length of side for the given polygon.

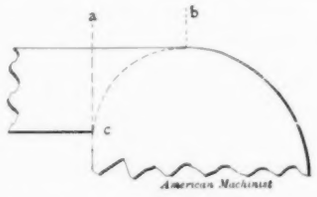
In another article on the same subject Mr. F. R. Honey shows us that this is not exactly correct, as the error increases with the number of sides, it being ¼ degree in excess for the pentagon, ½ degree in excess in the heptagon, and between 3 and 4 degrees in excess in the decagon.

JOSHUA ROSE, JR.

A Formula for Volumes Wanted.

Editor American Machinist:

Having a cylindrical horizontal pipe intersecting a sphere, the top of the pipe being tangent to the sphere, I would like



A FORMULA FOR VOLUMES WANTED.

the formula for ascertaining the volume of the pipe up to its intersection. In other words, the volume included between the lines a, b, c in the sketch.

ANONYMOUS.

The Use of Oils in Cutting Metals—Cooling the Tool.

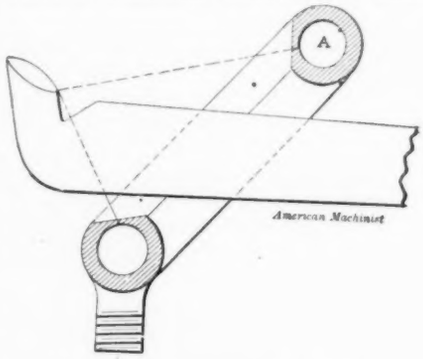
Editor American Machinist:

Your correspondent in Manchester understands the art of asking questions. "Are oils used to cool the tools or to lubricate?" is a big enough question to fill a whole shop, and still he condenses it to a space of not quite half a column at page 1342. I hope nobody will think I am going to answer the question, for I would have to disappoint him. I am, to a large extent, ignorant in this matter, and this is perhaps the reason why I think I have a right to talk about it. The way I would size up the thing is this: Sometimes it is used for cooling, sometimes for lubricating, very often for no special purpose, and still oftener with plenty of purpose but with no particular result. The "one drop every hour" method is intended for lubrication, but does it do it? The stream of oil of a diameter of 1-16 inch is intended for cooling, but does it do it? The running of oil on the finished part of the shaft to be turned up is certainly to no purpose whatever, except perhaps to give the oil pump some practice. The running of oil on the wrong end of the cutter of the milling machine has very likely the purpose of saving the cutter, of making a smooth cut, and of enabling one to use higher speeds, but I hardly believe it has any particular result.

This cooling matter seems to be often wrongly understood. Some machinists seem to have the idea that they must keep the work cool. This, of course, does no harm; but if you want to cool anything, cool the tool. It is the tool which gets spoiled by heat, not the work.

Everybody knows that friction creates heat, and as there is no way of cutting metal without considerable friction, it follows that heat must be developed whenever one tries to cut metal. If more heat is developed than can be carried off by the tool, and by the work in contact with the tool, the fool will get heated up to such an extent that it will burn out. This fact establishes the limit of cutting speeds for all ordinary kinds of tool steel. The most common means used to overcome this difficulty are flushing with oil, soap water or soda water, and the use of tools of very large section. These methods would have the desired result if they were properly employed, but the liquid used is generally poured on that part of the tool which is not heated, and, where heavy tools are used, the part of the tool where the heat is developed, is generally left of slender section. The section of the tool right behind the cutting edge is necessarily very small, and, therefore, cannot carry off much heat, and this will be more or less true whatever section is given to the tool. As to flushing with some fluid, this would have the desired result, if it were possible to reach the very cutting edge. This, howhowever, is not possible. The best way, perhaps, is with a stream of the lubricant from below; but even this does not exactly reach the spot.

I had been reasoning out to myself that if it were possible to cut metal without heating the tool, then there would be no limit to the cutting spee'. The only way I saw of accomplishing this was to counteract the heating of the tool by creating an intense cold at the tool point; in other words, by establishing a refrigerating plant



COOLING A TOOL BY COMPRESSED AIR.

in the immediate vicinity. Casting around for means to accomplish this, it struck me that I might just as well do it in the way refrig rating plants are usually constructed, though of course with a few minor changes.

The accompanying sketch shows the plant as used when I tried to demonstrate the correctness of my theory. A brass ring of a section, as shown at A, was placed around the cutting tool. Eight holes of 1-32 inch diameter were drilled in the ring, as shown, and compressed air at a pressure of 70 pounds per square inch was allowed to escape

and to focus to a point about one inch back of the tool point. From there on the air expanded and created a region of intense cold, which was strongest at the cutting edge. This position was gotten after a few trials. The tool was a lathe tool of ordinary Mushet steel. The piece in the lathe (a 16-inch lathe, by the way) was a 9-inch ram of a hydraulic press, which was condemned to the scrap heap on account of its hardness. The cut was 5-16 inch deep and with 1-32 inch feed. Gradually the speed was increased until a speed of 168 feet per minute was reached. This proved to be the limit, but not because the tool gave out, but because the lathe refused to pull at a higher speed. I then tried a piece of 3⅛-inch shafting, and ran the speed up to 210 feet a minute, when again the experiments had to be stopped on account of lack of power in the lathe. The chips coming from the lathe were cold, and the tool, after its severe trial, was colder than when I started.

When cutting the cast iron, a stream of chips shot up in the air like when turning wood and made it very uncomfortable for anybody who would venture near. This disagreeable feature, however, might be avoided by deflecting the chips, or, better still, by turning backward and holding the tool upside down. This method, though preventing the burning out of the tool, did not prevent it from getting dull. All other conditions being the same, the dulling of a tool depends on the amount of metal removed. Air blast or no air blast, a tool will dull after it has traveled a certain distance over the work.

This experiment was recalled to my mind when I read your correspondent's question about cutting oils. I would have liked to go further into this matter, but business was pressing, and I had to be satisfied with the fact that the lathe I used was the weak point, and not the tool.

A. L. De Leeuw.

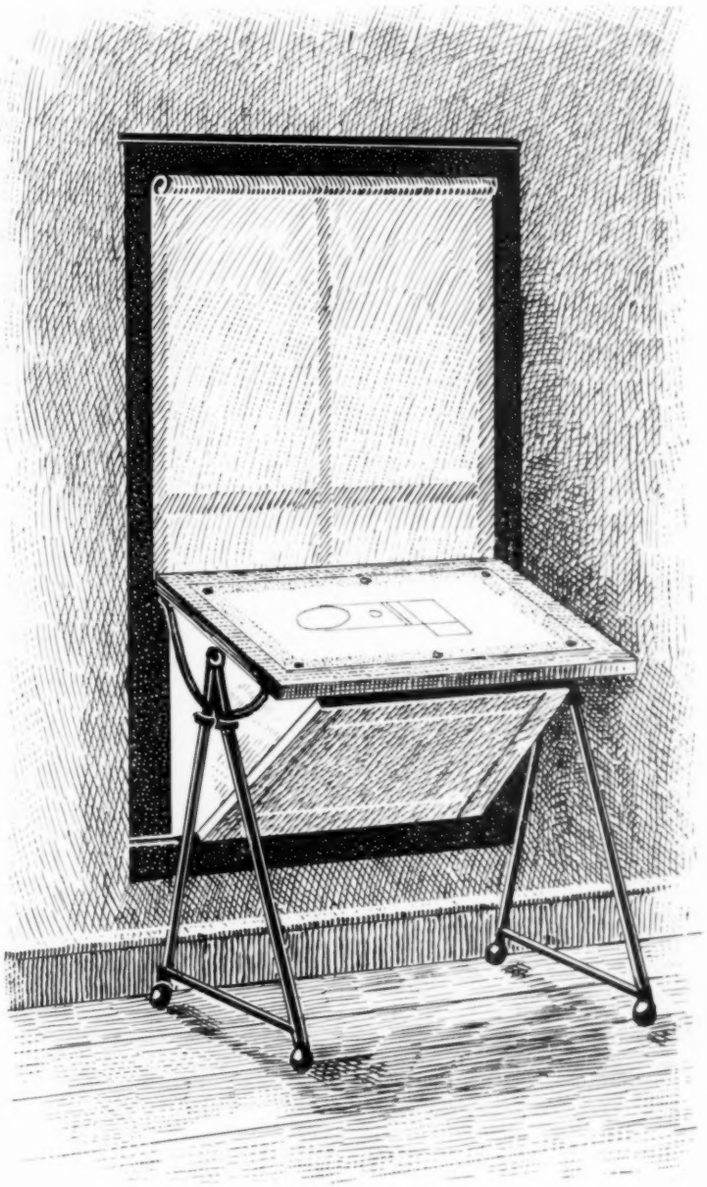
Hamilton, Ohio.

Copying Drawings.

Editor American Machinist:

On reading "Cherry's Red's" article on "Copying Drawings" at page 1315, of the American Machinist, I was reminded of my own experience some twenty years ago when the blueprint process was not as universal as it is now. At that time it was regarded with disfavor by European engineers and hand-made drawings were usually insisted upon. I was given the job of making about one hundred plans all alike to go to Russia and the specifications called for "hand-made drawings on white paper."

In place of a drawing board I had an open frame made of soft wood, into which was set a light of glass so as to be flush with the top of the wood. The glass was larger than the border line of the drawing, but smaller than the whole sheet, so that the original plan could be placed on the glass and the paper stretched over it and fastened by drawing tacks in the soft-wood frame. The drawing table was backed up against a window, the curtain drawn down to the drawing board, to keep out the top light, and a mirror or a sheet of white paper placed at an angle underneath the glass, so as to throw the light up through the drawing. Under these circumstances copying can easily be done through paper as thick as Patent Office board, and it is not necessary for the direct sunlight to strike the mirror; even diffused daylight will answer.



COPYING DRAWINGS.

The blueprocess is now so universal that we could hardly get along without it, and we have had it so long that it seems as though we had always used it, yet I well remember the many substitutes we tried before adopting it. When I was a lad I had a taste for chemistry and a taste of chemicals as well, for I was always experimenting. I was trying to find a substitute for nitrate of silver for sensitive paper which was then very expensive. I hit upon a combination of prussiate of potash, bichromate of potash and iron citrate of ammonium. This would yield a print of a pleasing gray color, but not very dark. I did not think of copying tracings, but of making prints of leaves and ferns and plant forms in which I was interested. I thought that something might be done with the process if the right proportion of chemicals could be hit upon.

I had an idea that the secret lay in the amount of bichromate of potash and so it proved, for, by *leaving it out altogether*, which someone did a few years later, the blueprint process was discovered.

W. H. S.

Small Planes for Patternmakers.

Editor American Machinist:

At page 1091, "X. Y." tells of a nice set of core-box planes, several of which

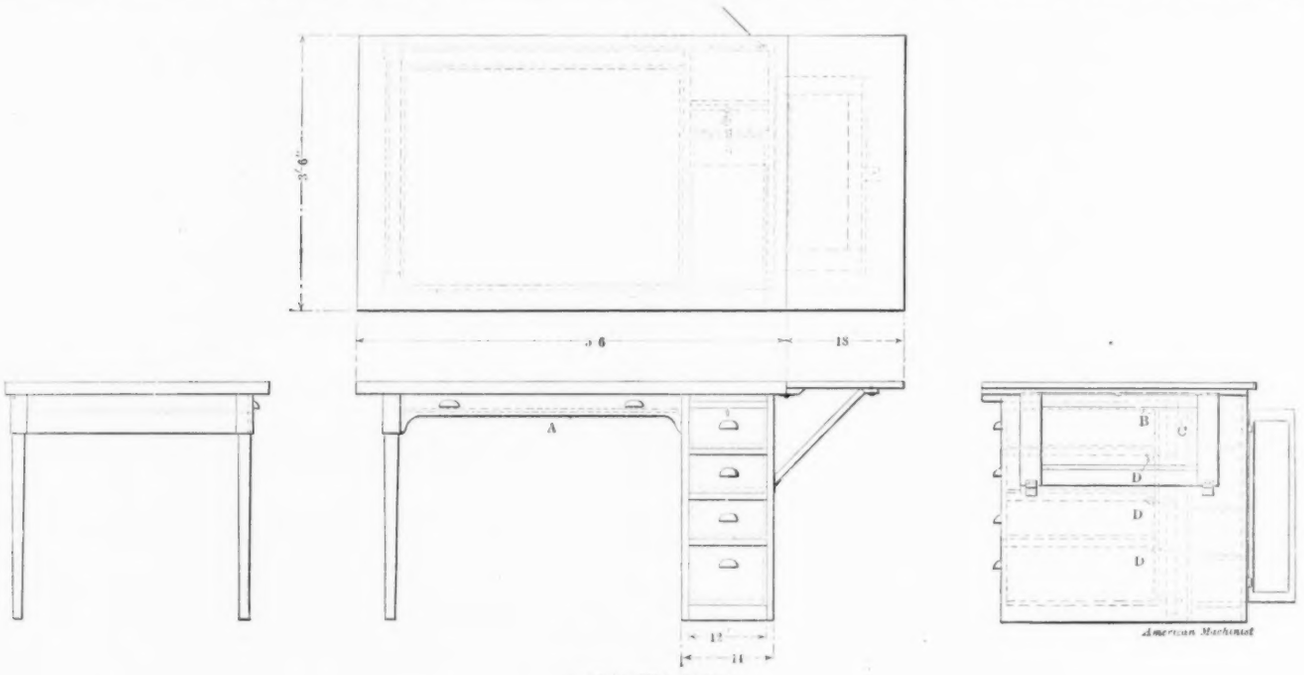
were appropriated from his little son's tool boxes. I would like to ask the gentleman at what age he expects his little son to become a first-class patternmaker or anything else if his father appropriates the tools with which he is to make his beginning? I didn't get my start that way.

J. E. P.

Drawing Table.

Editor American Machinist:

After seeing the recent illustrations in your paper relating to drawing tables, the thought came to me that a sketch and a description of one I had the good fortune to be very intimate with for several years, that proved to be very convenient, and was liked so well that the company whose office it was used in had about 100 of them built for their draftsmen, might probably be of interest to some of your readers. I made this sketch more to give an idea how the table was made than to give definite sizes, which of course can be made to suit the ideas of the builder, and, for this reason, dimensions would not amount to much even if I had them to give.



A DRAWING TABLE.

The top of the table makes a large drawing board, and, with the extension shelf at the end, is large enough to hold drawings and prints for reference, other than the one being worked upon. The large drawer *A* is for work that is not finished or for reference drawings that one does not wish to leave out upon the top of the table.

This drawer is only 2 or 3 inches deep, and the front edge of the table top or drawing board projects far enough to prevent the drawer from getting in the way of one's legs when sitting down to work. There are four drawers at the right-hand side of which the top one has a till for tacks, pencils, etc., and, in addition, room enough in the lower part for cases of instruments and other tools.

The second and third drawers were alike and made good storage places for note books, sketches and many other things that a draftsman accumulates. The bottom drawer is somewhat deeper than the others, to allow books to be placed with the backs up, to permit reading the titles at a glance. The top drawer had a lock on it, and locking this one locked all the others by the very simple device shown roughly in dotted lines in the end elevation. To unlock the lower drawers, one has to pull out the top drawer, until the wooden lever *B* at the top is raised by the cam-shaped end riding upon the back of the drawer. The raising of this lever causes the wooden bar *C* to move up and carry the fixed wooden hooks *D* with it, thereby unlocking all of the drawers.

Between the top drawer and the top of the table was a slide that can be pulled out, to write upon, I suppose, but to my mind it was superfluous, and I never found a good excuse for its being there.

It was decided that to carry the drawers all the way through to the back of the table would make them too long for convenience, and they were shortened. In the space thus made, a little closet was put in, which provided an excellent place to store up the variety of junk that comes to hand from time to time, and therefore I do not consider that this feature amounted to much.

The extension shelf at the end was arranged to be let down, and out of the way if so desired, by turning a wooden button that keeps the hinged brace in place.

The table was made of well-seasoned white pine, and when given a cherry stain, with a coat of varnish, it gave a pleasing appearance to the eye and made a drawing office look like what it was intended for, and not like a carpenter shop, as many do, with their boards upon trestles or horses.

G. J.

Jobbing and Manufacturing in the Same Shop.

Editor American Machinist:

From reading "Echoes from the Oil Country," which afford me much instruction, I have concluded that the writer runs a show similar in many respects to that over which it is my lot to preside. That the job is not a bed of roses needs no emphasis to those similarly engaged, but the difficulties are accentuated in my own case by the fact that in addition to the breakdown and jobbing work some attempt is made at manufacturing. We employ about fifty hands and tackle every sort of job that comes along—repairs to every kind of machinery under the sun, from a mortar mill to a wire stitcher. Wide as the range is, all this sort of thing can be negotiated, but it is manufacturing as well that causes the rub. Throw it up, Mr. Osborne will say! But what are we to do between whiles? If we relied on repairs and jobbing alone, we would occasionally have half the hands killing time. At other times we want twenty fitters instead of ten, our ordinary complement. This is what happens now: When a man comes back off a job or finishes a repair indoor, if there is no further call at the moment in that line he drops back on a stock job—that is, a machine he was making or helping to make before he was called away. Needless to say, the stock job suffers; everything we manufacture costs 25 per cent. too much, to say nothing of the endless worry, confusion and lack of system that pertain to such a condition of things.

Take a case. Jones is a gas engine man,

but there are not always enough gas engines going wrong to keep Jones busy. Between the jobs—and the gaps are sometimes of perhaps a day's duration—he is fitting up the gear for a factory hoist. He has had to leave this perhaps half a dozen times to see why somebody's engine wouldn't go; and one day, while he is out, the man who wants that gear wires that if it isn't sent immediately he won't have it. Smith, another fitter, has to drop a job he was doing and pick up the gear Jones left—find the pieces, fit another key perhaps to that worm shaft because he couldn't find the one that Jones had half fitted. Finally the gear gets completed and gets sent out of the shop with the paint wet. Whether it has suffered in point of quality or not, it is certain that, owing to the stops, starts and changes in men during the fitting up, the wage bill against it is heavy. The question of establishment costs in this matter, to my mind, is an important one. At present we have a rate that works out at about 50 per cent. of the wage bill, and this is charged on each hour worked by the man, whether he is fitting up a hoist gear in the shop or doctoring somebody's gas engine outside.

Now, fitter Jones is kept absolutely at the disposal of customers, such as the one in the above case, who wants his gas engines coaxed. Ought such customers to be charged with a higher percentage of establishment cost than the hoist gear which obviously suffers all along the line? I can see no other method of squaring matters. Unfortunately we do not get any chance (and it is, I suppose, the fault of engineers themselves) to charge a bit for "knowing how" to do a job. We do not get paid for advice like doctors and lawyers. In the vast majority of cases we get paid for *cures* only. Above all, this jobbing and manufacturing business precludes the possibility of standardizing in any direction or adopting repetition methods, and it baffles all cost systems with which I am acquainted. Is such a state of things inherent in such a case as ours, or can it be avoided? Perhaps someone similarly placed will compare notes.

Bristol, Eng. JUNIOR BOSS.

Gas Engine Piston Head Fits.

Editor American Machinist:

As often happens in shop practice, no hard and fast rule can be given for fitting piston heads of gas engines, but a little consideration of the conditions to be met will indicate what is needed. From this it can be determined what is necessary and the amount of allowance determined.

To those giving the construction and operations of a gas engine consideration it is of course very evident that the piston head gets much warmer than the cylinder and that this difference is greatest when the engine is developing most power.

This difference is also influenced by the thickness of cylinder walls, temperature of cooling water in the jacket, speed of engine, kind of cylinder oil used, quantity of cylinder oil used, etc., and also by whether the engine is two or four cycle, single or double acting, with or without cross-head, etc., and in large engines as to whether the piston head is cooled internally by water passing through it or not.

I think a very brief consideration of these conditions will show that this is a problem impossible of solution by the draftsman or designer, owing to the numerous uncertainties involved. He may make a very good guess at it, basing his guess partly on calculations and partly on previous experience, but is wise if he understands it is a guess, and acts accordingly.

Submitted to the Analytical Calculus of "cut and try" of the shops, this question becomes one that can be more nearly solved.

By fitting a head so it will be a working fit and putting it in and running it under working conditions and noting if it has any tendency to stick, it will be seen whether that is loose enough or not. It will generally be found too tight for hard work. It will also, if of the trunk type long head that takes its explosion at one end only, be found to be bearing hardest at the inner end. By easing off and trying a few times, the shape of the head and also the size may be found. This, then, may be taken as a standard for that make of engine and that size of the make.

When a head has been fitted in this way it will be found to be largest at the open end and smallest at the closed end, but it will not be a straight taper, but will be a curve, getting smaller more rapidly as the closed end is approached.

The amount of taper necessary in practice is very slight, except for the last part, where it is better to be liberal with the reduction as the head has a way of getting larger just at the end if the work is hard and continuous.

Having found the allowance suited to the engine and size of cylinder, the inside micrometer and any suitable gage for outside measurements will duplicate it.

The matter of a suitable quantity and quality of cylinder oil is one that is of great importance both to the maker and user. The heat due to friction will often cause a piston head to become red hot and stick and cut the cylinder, where, under the same conditions of load and speed and with a good oil in reasonable quantity, the engine will not even smoke. I believe the subject of oil almost a vital one to both the makers and users of gas engines and one that should receive very careful attention, as very often trouble is blamed on the engine that is entirely due to the oil used.

Starting with a small size cylinder and finding the proper allowance and then doing the same with a large one will give data enough for determining intermediate sizes very closely.

While it is desirable to make the fits as close as is safe, yet it is well to keep in mind that a tight head will do more harm than a loose one, and when a head begins to stick even good oil will get crowded out and both cylinder and head are likely to soon be in bad condition.

Should your reader who wishes information on this subject be repairing engines of various makes I would suggest that he give about double the allowance he would for ordinary working fits of the same size. Where the cylinders and heads are both very true and smooth this allowance should be slightly greater than where they are left rough. W. OSBORNE.

A Manchester Engineer on American Methods.

In the course of an interview, Mr. E. G. Constantine, M. Inst. M. E., A. M. Inst. C. E., president of the Manchester Association of Engineers, gave some interesting details of matters that had come under his observation during a recent business tour through the important industrial centers of the United States. First of all, he was struck by the marked indications of prosperity which characterized all the districts he visited. Everywhere, industrial developments in connection with buildings of various kinds, works and electrical installations were being pushed forward. A feature of American enterprise was the readiness with which capital could be obtained for new undertakings. The Americans were far more speculative than the people of this country; they were prepared to take risks in regard to new enterprises which would probably "hang fire" in England, and the taking of these risks in the long run apparently pulled them through to successful results. A further notable feature was the elaborate and perfect system adopted generally for the handling of heavy masses of material expeditiously and automatically. In this direction he considers the States are a long way ahead of English methods. He was also struck by the greater rate at which they worked in the engineering shops, particularly in the administrative and drafting departments. From the manager downwards they were at it ding-dong all day, and for much longer hours than would be thought of in this country. They paid higher wages, but they got more work per man out of their employees than we did in this country. On the whole, however, having had the opportunity of examining their highest samples of engineering work, he could honestly state that neither in design, workmanship nor finish was it in any way superior to work of a similar class turned out in England. There was plenty of second-rate work to be found in America, as elsewhere, and one or two of the much-vaunted establishments were certainly disappointing to him when he visited them. Despite the advantages the Americans possessed, he did not think we had much reason to feel despondent about their competition in engineering work in foreign markets.—*The Mechanical Engineer.*

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 759,000 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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The Length of the Work-Day.

While so much is being said about the eight-hour day, it seems strange that so few should appreciate the fundamental principle on which the question rests. It is not intended here to decide or to show how others can decide what the proper length of the day should be, for that is impossible. In this respect the question is like many others in economics—it is easy to point out tendencies and to establish fundamental principles, but it is an altogether different matter to say definitely just what such tendencies will have produced at a given time.

At the start it may be taken as a truism that from the workman's standpoint *that length of work-day is best which will secure for him and his family the maximum of comfort.*

The productive enterprises of the world are, in a broad sense, a great co-operative scheme for the production and distribution of wealth. However much one may feel that the distribution is unfair, no one can doubt that the more wealth there is produced the more there will be to divide, and the less there is produced the less there will be to divide. It follows that if a shorter work-day results in the production of less wealth it must in the long run reduce the workman's compensation—if not by a direct reduction of wages, then by an increase in the prices of those things which he buys.

Assume, in the first instance, that the amount of work done is in direct proportion to the time expended. In that case a shortening of the work-day to eight hours must in the long run be followed by a reduction of the workman's compensation. Against that is the increased comfort due to the added two hours of leisure each day, and the question to be decided is whether those two hours of leisure are worth as much to the workman and his family as the things which he might have bought with the earnings of the two hours had he spent them in the factory. In other words, as stated at the beginning, the question is whether the eight- or the ten-hour day secures the maximum of comfort for the workman and his family.

Assume in the second instance that the work done in eight hours is the same as in ten, and the question settles itself. In that case the two hours of leisure are absolute gain with no loss to set against it.

Assume in the third instance that the work done in eight hours is greater than in eight-tenths of a ten-hour day but less than in a full ten-hour day. For example, assume that in an eight-hour day the work done is equal to that previously done in nine-tenths of a ten-hour day. In that case the immediate loss to the workman will be the earnings of one hour per day, while the gain will be two hours of leisure per day and the question to be decided is again whether the two hours of leisure re worth as much to the workman and his family as the things which he might have bought with the earnings of another hour's work per day. This, however, is not all of the question, since if the eight-hour day were universally adopted, and if it led to an average reduction of 10 per cent. in the production of all goods, that reduction would necessarily be reflected in a general increase of prices and the workman would not be able to buy nine-tenths as many things as he did before.

From the workman's standpoint alone, the final result will obviously vary with different classes of work, as there is no doubt that the loss of output due to shortening the day will vary with different occupations, depending to a large degree on the use of machinery and on whether his work is manual or merely supervisory.

All this does not touch upon the return to capital, which is a much more complicated question. Under the second assumption—that the output will be the same in eight hours as in ten—the interest of capital in the question disappears, because, the output being supposed the same, the return to capital will be the same. However, it is obvious that this assumption cannot be true in the average case.

Under the third assumption, the workman might perhaps conclude that the two hours of leisure were worth as much or more to him than the earnings of another hour, even after allowance had been made for increased prices, but capital has no such compensation. From the standpoint of capital, a reduction in the output leads to loss and to nothing else. A direct 10 per cent. reduction in output is a serious matter, even though someone else is as well off or even better off than before.

In the long run the owners of capital must be regarded as a portion of the general public. The case must be reduced to the average man and the initial principle still holds—that length of work-day is best which will secure to the average man and his family the maximum of comfort, the increased leisure of a shorter day being balanced against lower wages or higher prices or both.

Before the highly organized industrial system which now prevails came about, the main point of the question was plainer than, though not different from, what it is now, and there are a few cases in which the old conditions still endure. The shoemaker and the country blacksmith, for example, deal directly with the consumer of their products. The workman's earnings under these conditions depend absolutely on the amount of work which he can do, and he is, day by day, compelled to choose between increased earnings and increased leisure. Under such circumstances we find the shoemaker, during the busy fall months when everybody needs new footwear, extending his hours of work far into the evening, and doing this voluntarily, because he considers the earnings of those evening hours worth more to him than leisure during those hours. Under the conditions of most industries, the employer intervenes

between customer and workman, the relations between earnings and production are obscured, and we hear much about ten hours' pay for eight hours' work. The intervention of the employer does not, however, change the fundamental principle. Under these conditions, as under the more simple ones of the shoemaker and the blacksmith, it is still, in the long run, impossible that ten hours' pay can be obtained for eight hours' work unless the old ten-hour day's work is done in the new eight-hour day, and the crux of the whole matter lies in the effect of the shorter day on the amount of work done.

Principles which are obviously true in simpler forms of communal life and industries are not abrogated or annulled, though they may be obscured, by more complex social organization. Of course it is a fact that in those industries in which machinery has very much lowered the cost of production it is true enough that a shorter work day will enable as much or more work to be done than in the longer day working without this machinery, and this fact affects the solution of the question, or becomes a factor in the equation, so to speak; but another factor is found in the further truth that this greater productive power of labor by the use of machinery has resulted in generally much lower prices for finished goods, in the benefits of which all consumers of such goods share in proportion to their consumption of them, whether they be workmen or capitalists. Though these factors further complicate the problem, still we believe the general principle we have enunciated holds good. It is in fact in accordance with the law generally recognized by economists, *i. e.*, that "men seek to supply their wants with the least possible exertion"—the law which is at the bottom of all our material progress and advance in the industrial arts, but which may be also perverted, as for instance in the establishment and maintenance of human slavery, in order that a few men may supply their wants without any exertion whatever. It still holds good that, from the workman's standpoint, that length of day is best which will secure for him and his family the maximum of comfort.

Staying Out of the Foundry.

The proprietor of a large machinery-building establishment was standing in the foundry the other day with some visitors and, pointing to a large mold in the floor, he said: "We shall pour that to-morrow, or rather the molders will do it. We never go inside the foundry when such a job is being done." In reply to a question he said this was because the men were more or less bothered or "flustrated" by visitors when pouring an important mold and mistakes or blunders were much more likely to occur if visitors or anyone not regularly employed in the foundry were present.

This leads us to wonder how many employers are so considerate of their foundrymen. A great many employers we know make it a point to be on hand when an important casting is poured, thinking perhaps that their presence will tend to make the men more careful and to prevent mistakes or blunders. It is more than probable that the presence of anyone not regularly employed in the foundry has directly the opposite effect. It is quite certain that the molders and the foundry foreman usually feel, to the fullest extent, the weight of responsibility upon them when a casting weighing many tons is to be poured, and the presence of no one can possibly add to this feeling of responsibility in any useful way. It is probable that the proprietor referred to takes the right view of it and that it is better for visitors and proprietors to stay away from a foundry when an important casting is to be poured.

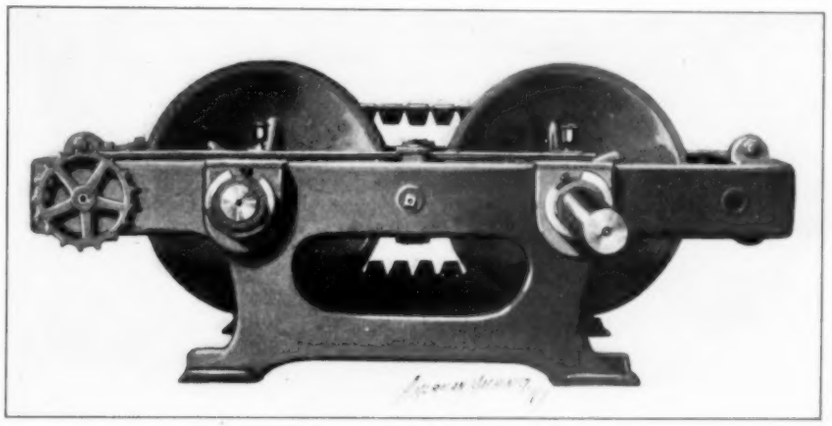
Counterbalances for Locomotive Cranes—Erratum.

The author of the article on the above subject, at page 1329, points out an error in the ninth line from the bottom of the middle column. The word *maximum* should read *minimum*.

Some New Tnings.

NEW DESIGN OF VARIABLE SPEED DEVICE.

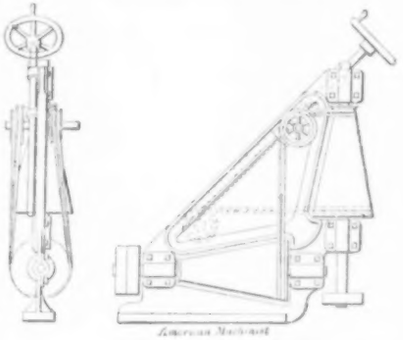
We have on previous occasions informed our readers regarding the construction and the advantages of the Reeves variable speed transmission device, and we show herewith the latest form of this device in which the frame, instead of being built up of steel, is cast in two pieces, these two pieces taking the place of twenty-eight pieces in the old form of frame. In this new form the hangers are cast solid with the frame, and the builders state that experience with the new frame demonstrates that it is much superior to the older one. The photograph shows readily enough that it is certainly superior in point of appearance. It is made by the Reeves Pulley Company, Columbus, Ind.



VARIABLE SPEED DEVICE.

A SPEED-CHANGING DRIVE.

This device will be readily understood from the cut. It may be used in any position, but, as here shown, the tight and loose pulleys on the horizontal shaft may be considered to carry the belt by which it is driven, while the belt on the single pulley on the vertical shaft leads off to the



A SPEED-CHANGING DRIVE.

machine whose speed it is desired to change. The belt from one cone to the other is carried over the idler pulleys on the saddle which slides on the inclined part of the frame. The driven cone will evidently run slower if the idler pulleys are moved down the incline and change the position of the belt. The dotted lines show the position of the belt and idlers for the slowest speed. There is a spring actuated movement for the idler pulleys to maintain the required tension upon the belt and to allow it to slip in case of obstruction to the driven machine, and thus prevent accident or derangement. The device, it will be seen, comprises a right-angled instead of a parallel drive. In the end view at the left the tight and loose pulleys are removed. The inventor of this drive is H. P. White, Kalamazoo, Mich.

Convention of Branch Office Managers of the Crocker-Wheeler Company.

A special feature with the Crocker-Wheeler Company is its annual convention of branch office managers. The latest of these was held at the works, Ampere, N. J., September 25 and 26, the

annual banquet occurring at the Engineers' Club on the evening of the 25th. The convention is to bring the men closer together to compare notes and plan methods for handling the largely increased business of the company. At the dinner were the officers of the company, Schuyler S. Wheeler, Gano S. Dunn, W. L. Brownell, Putnam A. Bates, C. N. Wheeler and F. V. Henshaw, and the branch managers, Samuel Russell, Jr.; Julian Roe, J. Hally Craig, Louis P. Hall, W. H. Wissing, Francis B. De Gress, Henry J. Sage, William A. Doble and Harold Lomas. Many interesting speeches were made and a token of esteem was presented to Mr. Putnam A. Bates, the general sales manager.

Technical Publications.

"Aerial Navigation." By Frederick Walker. 151 5x7½-inch pages, with 104 illustrations. D. Van Nostrand Company, New York; Crosby Lockwood & Son, London. Price, $3.00.

This is the first book upon this subject which we have seen which can be called a systematic treatise, though it does not profess to be a deep one. It discusses in separate chapters the Flight of Birds and Insects, Aerostatics, Aerostats, Aerodynamics, Screw Propellers and Aeroplanes, Motive Power, Structure and Materials of Airships, and Actual Airships.

The author believes in the future of the airship, and says "the airship will soon cease to cause astonishment." At the same time he admits that "from a commercial point of view the advantages to be derived from any increased speed due to aerial navigation as against other modes of locomotion are not immediately apparent except for light postal services." He considers that the airship will "combine the aerostat, aeroplane and mechanical propeller," and his last paragraph says "no human mind can foresee the airship of the future, except that aerial navigation will be a matter of every-day usage and will give rise to a new industry throughout the world."

The name of the Cleveland Machine Screw Company has been changed to Cleveland Automatic Machine Company, which latter name fits the business much better.

The largest textile machinery works in the world is that of Platt Bros. & Co., at Oldham, England. It covers over 61 acres and an average of 14,000 persons are employed. The head of the firm, Samuel Radcliff Platt, has recently died, fifty-seven years old.

The United States Civil Service Commission announces that on November 11 an examination will be held for the selection of a man for the position of "canceling machine expert and electrician." The salary will be from $1,200 to $1,600 per annum, and persons desiring to compete should apply to the United States Civil Service Commission, Washington, D. C., for particulars.

The Western Society of Engineers sent to its members a paper containing the written opinions of members for and against the adoption of the metric system; 153 members voted, and of these 130 voted to have the society endorse the bill now pending before Congress for the adoption of the system by the various departments of the government. Twenty-three voted against it.

The West Side Branch of the Young Men's Christian Association, on West Fifty-seventh street, in this city, claims to have the best equipment of any Y. M. C. A. in this country. It has a large and admirably adapted building and a membership of over 2,300. The current expenses are over $50,000 a year, half of which are met by membership fees, rentals, etc., and the balance by donations. There are 48,000 volumes in the library, and 600 students in the forty evening educational classes. There are classes in gymnastics and athletics afternoon and evening. The Association has a savings fund department, employment bureau, dormitories, restaurant, a boarding-house record and other features helpful to young men. It began its sixth season's activities on October 1st.

Personal.

C. V. Kerr, formerly professor of mechanical engineering in Armour Institute of Technology, Chicago, is associated with Westinghouse, Church, Kerr & Co., engineers, 8-10 Bridge street, New York.

Joseph Froehlich, until recently connected with the designing of the Dow composing machine, has gone to Detroit to assume the duties of chief draftsman at the Boyer plant of the Chicago Pneumatic Tool Company.

Obituary.

Robert McGregor, son of John A. McGregor, superintendent of the Morse Twist Drill & Machine Company, died in New Bedford recently, of an attack of appendicitis, aged nearly seventeen years. Robert was a good and a promising boy, and the many friends of his father will deeply sympathize with him in his sad bereavement.

Robert L. Peck died at North Creek, N. Y., September 26, forty-two years old. Mr. Peck began his shop career in the Pratt & Whitney drafting room, where he became expert as a designer of machinery. He left that establishment with Mr. W. L. Cheney to form the Meriden Machine Tool Company and later he became head draftsman of the New Britain Machine Company. His home was in Kensington, Conn.

Miss Mabel Allen, daughter of Francis B. Allen, vice-president of the Hartford Steam Boiler Inspection & Insurance Company, died October 1 from burns caused by an exploding kerosene lamp. Miss Allen and her mother were reading in the parlor of their home when the kerosene overflowed from the reservoir of the lamp and got on fire. Miss Allen attempted to throw the lamp out of an open window, but the screen was in place and the lamp rebounded into the room, and the flames enveloped her. Mrs. Allen, in trying to rescue her daughter, fell to the floor, breaking her shoulder and terribly burning her hands. Miss Allen broke through the window on to the lawn and tried to put out the flames by rolling on the grass. Neighbors came to the rescue and extinguished the flames, which had set fire to the house, and rescued Mrs. Allen, but no one noticed that Miss Allen was on the lawn. She was at last discovered, but was terribly burned.

Commercial Review.

NEW YORK, October 6.

Now that the fall trade has set in, and the advent of the winter trade can be chronicled in a few weeks, builders of machinery have been enabled to form some idea of the probable trade the near future will bring forth.

When a question with this end in view is applied to manufacturers of machinery, it is surprising the optimistic strain in which they answer it. The writer, who has consulted many of them, has yet to find anybody who viewed the future outlook for trade in other than with the assurance that the developments it will bring forth will have a satisfactory aspect to them. Even among those who feel that they are perhaps taking too rosy a view of the situation, there is an inability to detect the slightest cloud on the horizon.

Commercial agencies, which keep a close watch on business conditions throughout the country, are a unit in the belief that they never presented a more gratifying aspect than at present. Statistics recently compiled, for example, show that the failures for the past nine months of the present year were the smallest numerically in nine years except 1899 and 1900, and the liabilities for the nine months the smallest, with the exception of 1899, in ten years, and with two exceptions the smallest in twenty years. This is a magnificent showing, and justifies the optimistic predictions of future trade made by manufacturers of machinery and others.

Formal announcement of the complete organization of the Morgan Shipping Company was made recently. The constituent companies include nearly all of the leading ocean lines operating steamers between New York and leading English ports.

Manufacturers of machinery are wondering whether any notable changes will

be made in the freight rates. The impression is that the latter will be revised, but whether the revision will mean an increase or decrease in freight charges is a matter of conjecture for the time being. It is a noteworthy fact, however, that while American producers of pig iron opened their books for orders for iron deliverable in 1903 some two months ago, foreign producers have not opened their books for the same period, as a general rule. One of the chief reasons assigned for the course they are pursuing is that they want to hear definitely from the Morgan Shipping Company regarding the freight rates it is going to charge. The latter form an important part in all trades in pig iron between the two countries.

The annual report of the American Shipbuilding Company for the fiscal year ending June 30 was promulgated recently, and shows an increase in net earnings of $509,009, and an increase in the surplus of $10,619. President W. L. Brown, in his report to the stockholders, says: "During the year the physical condition of each plant has been kept to the highest standard of efficiency as far as possible, the expense incident to this having been charged to operating expenses. It has been found necessary to enlarge the foundry and pattern shops at Detroit, to erect some new buildings at West Superior, to make some alterations and repairs at Buffalo and to add some new tools and machinery at several of the plants. This work is now in progress, and to pay for it a special sum of $200,000 has been set apart, as shown in the treasurer's report. Work done and under construction is as follows: Vessels built, 41; carrying capacity, net tons, 198,500; vessels under construction, 30; carrying capacity, net tons, 139,900."

Architects in this vicinity say that during the past year the tendency of owners of both business and private dwellings, to install and operate their own electric lighting system, has been most marked. One builder of engines in New York, having noticed this, has made the work of supplying engines adapted for electric lighting service a specialty, and says that orders received by him since he began have more than met his expectations. Speaking of the outlook for this character of trade, he stated that he regarded it as yet in its infancy. He also said that he had no hesitation in asserting, and could produce facts and figures to prove it, that it was cheaper for the owner of any large business or private building to make his own current than purchase it. At the same time he was candid enough to admit that there were some grounds upon which the propriety of his conclusions could be questioned, but was sure that the preponderance of evidence was on his side.

The inability to procure fuel and the high prices demanded for it wherever it is obtainable, have seriously interfered with the operations of foundries, particularly in the East. The small foundries have been the biggest sufferers, and from a gentleman who makes a specialty of taking orders for castings for foundries in all parts of the country, the writer learned that many small foundries have been forced to close, particularly in New York State. This gentleman says that large foundries have not felt the adverse situation so seriously, because they generally contract for their year's supply of coke in advance, but even at that they have been unable to have it delivered to them satisfactorily. This puts it up to the railroads, who ascribe their inability to transport the coke to lack of cars, but the opinion is pretty well grounded that the real reason is that they find it more profitable to move other kinds of freight.

The Cincinnati Planer Company, of Cincinnati, Ohio, continue to make extensive improvements to their plant and equipment. They are now installing a 150 horse-power boiler, a 50-kilowatt generator and a 25 horse-power motor, 14 and 18-inch Lodge & Shipley lathes, 36-inch Schumacher & Boye lathe, 48-inch G. & E. automatic gear cutter, 16-foot Bridgeport automatic screw lathe, No. 3 Owen miller, 3 and 5-foot Fosdick radials, Higley cold saw and several of their own planers. They report a steady run of orders and predict a prosperous year for 1903.

Kates & Box, of No. 56 Pine street, are in receipt of some good orders from South America for engines, boilers and woodworking machinery. Norbert B. Bates, of this firm, has been in South America several months looking after the firm's interests, and letters received from him tell of American machinery making wonderful headway in that country. Mr. Kates will not return to New York for several months yet.

In this column, last week, reference was made to certain litigation in which the Philadelphia Pneumatic Tool Company and the Chicago Pneumatic Tool Company were involved relative to the Moffett patent, and the inference might have been taken that the restraining order issued by Judge Lacombe applied to the whole country. The fact is that it applied to the Southern District of New York only.

The American Gas Furnace Company, of 23 John street, have had a large number of inquiries for fuel gas plants since coal became so scarce and dear. A few of these have been from owners of private dwellings, for which the company does not think its fuel gas system is adapted. The company claims its gas machine is particularly efficient in annealing and hardening work, and orders along these lines have been received in good-sized proportions recently. The company has so many domestic orders on hand that the extension of its foreign business is not being vigorously pushed for the time being.

The Vonnegut Hardware Company, of Indianapolis, Ind., have received an order from the Haynes-Apperson Company, of Kokomo, Ind., for thirteen lathes, seven drill presses, three shapers, one milling machine, one gear cutter and some smaller tools.

The National Machinery Company, of Tiffin, Ohio, state that the condition of trade during the last thirty days has been highly satisfactory. Orders of considerable size for bolt, nut, wire and nail machinery have been steadily coming in, and to enable themselves to satisfy customers and to live up to deliveries they have lately doubled their capacity by the addition of new machinery, and are in much better shape than ever to get out orders quickly. From the inquiries that are being received from every quarter, to say nothing of the orders, the company thinks the outlook for the winter and spring very promising, and are confident that they will have all the business that they can handle.

The National Acme Manufacturing Company, of Cleveland, Ohio, has opened a branch office at Nos. 2 and 4 South Canal street, Chicago, with George D. Grant in charge.

Makers of machinery are well represented in the exhibits at the Mechanics' Fair, which recently opened at Boston, and which will continue for several weeks to come. One of the largest exhibits is that of the Boston firm of Chandler & Farquhar, consisting of thirty-eight up-to-date, latest pattern machine tools, including engine lathes, radial drills, grinders, upright drills and power presses, some of which are in operation by direct motors, the power being furnished by a Cooley cycloidial engine, the only engine ever made upon this principle, and the smallest doing the same amount of work, being only 2 feet 3 inches by 1 foot 2 inches over all, furnishing also at the same time power for 300 electric lights. Practical machinists are in charge of the exhibit and standard goods are in process of manufacture for the American Roller Bearings Company. The popular goods of Brown & Sharpe, Morse Twist Drill Company, Norton Emery Wheel Company and the Armstrong Bros. Tool Company are included in the exhibit, the whole constituting one of the most elaborate and attractive massing of modern machinery, tools and supplies ever seen in Boston.

Imports of iron and steel have doubled in the last year, while exports of iron and steel are still falling off. The August import and export figures of the Treasury Bureau of Statistics show that the importations of iron and steel manufactures for the eight months ending with August are $11,000,000 greater than in the corresponding months of last year, while the exportations of iron and steel manufactures are nearly $5,000,000 less than they were in the corresponding months of last year, and $21,000,000 less than in the corresponding months of 1900. In the single month of August, the imports increased more than $2,000,000 over those of August, 1901, and at the present rate of gain the

total imports of iron and steel in the calendar year 1902 will exceed those of 1901 by $20,000,000.

The following table, from the "Advance Sheets" of the Treasury Bureau of Statistics, shows the importations of iron and steel manufactures in August, 1902, compared with August, 1901:

Articles Imported.	Aug., 1901.	Aug., 1902.
Pig iron	$147,557	$1,407,393
Ingots, blooms, slabs and billets	84,213	948,608
Iron ore	230,237	251,159
Machinery	171,755	343,472
Tin and terne plates and taggers' tin	570,222	188,842
Scrap iron and steel	68,712	185,914
Cutlery	170,153	148,598
Bar iron	126,034	108,030
Firearms	118,500	96,223
Wire rods	97,529	81,381
Railway bars of iron or steel	537	53,704
Wire and articles made therefrom	30,801	41,196
Needles	30,198	32,907
Sheet, plate and taggers' iron	49,084	28,723
Shotgun barrels	24,363	18,431
Hoop, band or scroll iron and steel	14,356	17,138
Chains	7,094	2,920
Files, rasps and floats	1,238	2,488
Anvils	587	206
All other articles	152,839	417,140
Total iron and steel, including iron ore	$2,090,009	$4,374,473

Bids were recently opened by the government authorities for machinery for installation at the League Island Navy Yard. The bidders, with the machinery on which they made bids, are as follows:

Bidder 1. J. W. Cregar, The Bourse, Philadelphia, Pa.
2. Morgan Engineering Company, Alliance, Ohio.
3. Niles Tool Works Company, 3d and Mills streets, Hamilton, O.
4. Manning, Maxwell & Moore, 85 Liberty street, New York city.
6. Northern Engineering Works, Detroit, Mich.
7. General Electric Company, Schenectady, N. Y.
8. The Alliance Machine Co., Alliance, O.
9. Pawling & Harnischfeger, Milwaukee, Wis.
10. E. H. Johnson, Jr., & Co., 337 N. 15th street, Philadelphia, Pa.
13. Fairbanks Company, Broome and Elm streets, New York.
17. Bement, Miles & Co., 21st and Callowhill streets, Philadelphia, Pa.
18. Almon & Garrett, 102 South street, Baltimore, Md.
19. Prentiss Tool & Supply Company, 115 Liberty street, New York.
20. The Rahn-Mayer Carpenter Company, 2935 Spring Grove avenue, Cincinnati.
21. J. W. Paxton Company, 1021 North Delaware avenue, Philadelphia, Pa.
22. N. J. Foundry & Machine Company, 9 Murray street, New York.
23. W. H. Foster, 126 Liberty street, New York.
24. The Drew Machinery Agency, Manchester, N. H.
25. Manhattan Supply Company, 127 Franklin street, New York.
26. The Brown Hoisting Company, 26 Cortlandt street, New York.
27. Garvin Machine Company, Spring and Varick streets, New York.
28. Springfield Machine Tool Company, Springfield, O.
30. Challenge Machine Company, 2233 Turner street, Philadelphia.
31. The North Penn Iron Company, North Penn Junction, Philadelphia.
32. W. E. Shipley, The Bourse, Philadelphia.
34. E. J. Etting, 1000 Land Title Building, Philadelphia.
35. R. C. Hoffman, P. O. Drawer O, Baltimore, Md.

Class 1. 2367 ft. guard rail and other similar material—Bidder 35, $7,106.52.
Class 2. One hand crane—Bidder 9, $1,350; 4, $1,450; 6, $1,485, $1,565 and $1,985; 34, $1,500; 3, $1,848; 22, $1,984.
Class 5. Two universal turret lathes—Bidder 4, $740 and $637; 1, $1,260; 13, $1,500.
Class 6. Two spindle drilling machines—Bidder 19, $90; $1, $95; 4, $95 and $115; 13, $210.
Class 8. One foundry cupola—Bidder 21, $737.50; 34, $809; 6, $845.
Class 9. Three blowers—Bidder 7, $420.
Class 10. One electric traveling crane—Bidder 32, $2,850; 4, $3,300; 22, $3,395; 6, $3,590; 9, $3,600; 3, $3,650; 34, $3,725; 2, $4,200; 8, $4,390; 26, $4,643.
Class 11. One metal planer—Bidder 19, $998; 4, $1,089; 13, $1,050; 1, $1,100; 27, $1,280; 3, $1,400.
Class 12. Two plain milling machines—Bidder 4, $575; 1, $1,050; 13, $1,050; 32, $1,100; 27, $1,300.
Class 13. One 38 in. lathe—Bidder 13, $1,750; 10, $1,793; 3, $1,995 and $2,600; 28, $2,260; 4, $2,500.
Class 14. One 12 in. lathe—Bidder 13, $255; 4, $276; 1, $340.
Class 15. One 16 in. single geared crank shaper—Bidder 3, $239 and $245; 27, $250; 13, $257; 32, $260; 4, $265; 1, $275; 23, $395.
Class 16. One 26 in. triple geared rack shaper—Bidder 3, $384 and $445; 32, $405; 13, $415; 4, $420; 1, $460; 23, $533.
Class 17. One 5 ft. arm radial drill—Bidder 4, $945; 13, $1,025; 3, $1,125; 1, $1,150.
Class 18. One set plate bending rolls. Bidder 24, $1,100 and $1,165; 4, $1,235; 1, $1,290; 23, $1,296; 13, $1,450; 3, $1,550.
Class 19. One single punch or shear—Bidder 24, $682 and $965; 23, $732; 1, $735; 13, $845; 4, $898; 3, $900 and $1,000.
Class 20. Two 13 in. speed lathes—Bidder 3, $37.35; 4, $96; 13, $170.
Class 21. One horizontal boring and drilling machine—Bidder 13, $1,230; 3, $1,820; 17, $3,025; 4, $3,100.
Class 22. One 12 in. slotter—Bidder 1, $1,130; 4, $1,350; 17, $1,550.
Class 23. One 24 in. lathe—Bidder 32, $525; 1, $650 and $695; 27, $700 and $730; 13, $710; 10, $746; 3, $750; 4, $754; 28, $825.
Class 24. One wet grinding machine—Bidder 1, $59.20; 13, $65; 4, $78; 25, $157; 30, $240.
Class 25. One fox lathe—Bidder 3, $424; 4, $475; 24, $511; 28, $570.
Class 26. One 37 in. boring mill—Bidder 19, $1,400; 4, $1,490; 3, $2,050.
Class 27. Two 20 in. drills—Bidder 4, $50; 18, $119.60; 19, $124; 13, $154.
Class 28. Two 16 in. engine lathes—Bidder 4, $460; 20, $750; 1, $794 and $1,000; 10, $875; 13, $930; 32, $990; 28, $1,066.
Class 29. Two 18 in. engine lathes—Bidder 1, $936 and $1,190; 10, $1,047; 4, $1,050; 13, $1,100; 32, $1,240; 28, $1,260.

CHICAGO MACHINERY MARKET.

It is not easy to reconcile some of the reports that are made concerning the Western markets for machinists' supplies and kindred lines. In the main a most satisfactory trade is reflected by the statements made, but there are exceptions. Some factors say business is becoming quiet, as compared with the past summer. Perhaps a reconciliation can be made on the theory of a shifting of trade rather than of a shrinkage. Thus selling interests that have been closely identified with the large agricultural implement trade in the West are somewhat at sea and a reasonable explanation is that the changes incident to the merging of the various constituent companies into the combination may account for the interruptions. Another general explanation is contained in the remark of a large seller of supplies, when he said: "We have to go after trade." So uniform has been the demand with all manufacturers for a year or two past that it has been unnecessary to solicit business in many instances. But some sellers are putting their men on the road again, and those who wait for the buyer to come to them are not faring so bountifully as before. On the whole, Western business in the machinists' tool and supplies lines may be said to be ahead of what it was at this time last year. "Ridiculously good" is the expression used by a representative of Samuel Harris & Co. C. H. Besly & Co. have increased their shop capacity 50 per cent. in the past three months, and because of the largely increased business are now erecting at Chicago a larger store building. The Machinists' Supply Company say trade is far ahead of what it was at this time last year.

A rather curious circumstance is that stove makers have lately been buying supplies more freely than usual. It has been common report that on account of the anthracite strike the trade in stoves, particularly the base burners, has been disappointing. Perhaps the impetus has come from the sale of wood and other cheaper makes of stoves. The sale of bolts, screws and similar lines is not altogether satisfactory, and here and there may be heard the words of a pessimist among the sellers of crude metal material.

With the Reeves Pulley Company the only trouble has been to make prompt shipment. Prices are not quite so good as they were, but there has been no summer dullness this year and business in volume was never better than now. One recent transaction was a sale amounting to $5,700 to the Tonawanda Board & Paper Company, Tonawanda, N. Y.

For the first nine months of 1902 the Chicago Belting Company's business is said to have been 60 per cent. better than for the same period last year. The company recently sold in Philadelphia for installation in electric plants throughout Pennsylvania two 58-inch belts, one 42-inch, one 36-inch and one 30-inch, all three ply.

Quotations.

NEW YORK, Monday, October 6.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:	
No. 1 X	$23 50 @ $25 00
No. 2 X	22 75 @ 23 50
No. 2 plain	22 25 @ 22 50
Southern:	
No. 1 Foundry	22 00 @ 23 00
No. 2 Foundry	21 75 @ 22 50
No. 3 Foundry	21 25 @ 22 75
No. 4 Foundry	20 25 @ 21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅝ @ 11¾c.; electrolytic and casting, 11.40 @ 11.50c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 25.20 @ 25.25c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5⅝c.

Antimony—Cookson's, 9½c.; Hallett's and U. S., 7¼ @ 7¾c.

Lard Oil—Prime City, 78 @ 82c., according to brand and quantity ranging from one barrel up to large lots.

Manufacturers.

The Rome Stove Works, owned by Bowie & Terhune, Rome, Ga., may be rebuilt.

Union Typewriter Company, Bridgeport, Conn., is about to build an addition.

The Standard Machinery Company, Chattanooga, Tenn., is erecting an addition.

Plans have been made for a $50,000 plant for the Binner-Wells Engraving Company, Chicago.

A sawmill of the Eland Traffic Company, Ltd. (main office in Oshkosh, Wis.), has been burned.

A building is being erected at West Bethel, Me., for use as a machine shop by Herrick Brothers.

The Dale Company, Whaleyville, Md., is erecting a plant to manufacture staves, barrels, etc.

The Parr Wagon Works will remove its manufacturing plant from Irwin, Pa., to Greensburg.

A three-story addition, 30x74 feet, will be built to the National Brass & Iron Works, at Reading, Pa.

The Northwestern Redwood Company's big mill near Willits, Cal., has been burned in whole or in part.

The Duranoid Manufacturing Company, Newark, N. J., is to erect a new factory building to cost $30,000.

The American Can Company, of New York city, has purchased 2½ acres at Rome, N. Y., for its new plant there.

Work is in progress on the construction of the new plant of the American Cabinet Company at Tonawanda, N. Y.

The Pierson-Sefton Company is building in Jersey City, N. J., a factory for the manufacture of horticultural appliances.

Land has been donated by citizens of Santa Fe, N. Mex., to the Santa Fe Central Railway Company for the erection of shops.

A foundry building, 75x256 feet, to cost about $40,000, will be erected for Smeeth's Copper & Bronze Company, Chicago.

Radford Bros. Company, Oshkosh, Wis., will build an addition, which will give enlarged space for the door-making department.

Contracts have been signed to erect a new factory building for G. W. Blabon & Co., oil cloth manufacturers, Philadelphia, Pa.

A four story and basement brick brew house, 605x40 feet, will be built for the Rosenegk Brewing Company, Richmond, Va.

The Snider-Hughes Company, builder of pumping machinery, Cleveland, O., has purchased land and will erect new factory buildings.

Ground has been broken for the erection of car shops and a roundhouse, to cost $80,000, at New Castle junction, by the Baltimore & Ohio Railroad.

Permission has been obtained to build two brick manufactories for the Detroit (Mich.) Steel Cooperage Company; estimated cost of buildings, $30,000.

Jacob Delp has bought land in Pittsburgh, Pa., and it is rumored that he intends erecting a factory for the manufacture of bar fixtures and kindred goods.

The Southern Pacific Railroad Company has been clearing ground for rebuilding the roundhouse and machine shops in Grant's Pass, Ore., destroyed by fire.

The galvanizing department and pipe stock house of the Harrisburg (Pa.) Pipe & Pipe Bending Company has been burned, but will immediately be rebuilt.

It is reported that the Hough Porch Shade Corporation will move its plant from Worcester, Mass., to Janesville, Wis., building a $15,000 plant at that place.

Edward A. Munson, of the Grand Rapids (Mich.) Edge Tool Works, has purchased a lot and will erect a 60x100-foot building, in which the company will be housed.

Plans are being, or have been, completed for an eight-story factory building, 110x110 feet, to be erected for the Liquid Carbonic Acid Manufacturing Company, Chicago.

A. L. Henderer's Sons, machinists, Wilmington, Del., have awarded a contract for a new machine shop building at Maryland avenue and Beech street, at a cost of $6,500.

Work is about to be commenced on the erection of an immense building to be used by the Pittsburg Railways Company as a power plant. It will be located at Brunot's Island.

Fire in a building occupied by the Sturtevant Mill Company, Boston, Mass., manufacturer of stone and crushing mills, has resulted in some damage to stock and machinery.

It is reported from Clarksburg, W. Va., that New York capitalists have chartered the West Virginia Iron Works and will erect an iron and steel plant at Steelton, a suburb of Clarksburg.

Plans are in preparation for additions to the cloth mill of Jacob Miller, Sons & Co., Philadelphia. These include an engine and boiler house and a dye and finishing mill building.

An $800,000 paper mill, with a capacity of 125 tons a day, is to be built at Saulte Ste. Marie, Mich., by a company organized and controlled by the Consolidated Lake Superior Company.

Several citizens of Vandalia, Ill., have in view the erection of a new paper mill. R. S. Fram, of that city, a practical paper maker, has offered to take a substantial interest in the project.

The Chattanooga Machinery Company, manufacturer of engines, sawmills, etc., Chattanooga, Tenn., is putting up a foundry and machine works, the building for which will cost $25,000.

Grading has begun for a tile and paving brick plant to be built near Des Moines, Ia., by Charles Rawson. The plant, which will be completed next summer, is estimated to cost about $100,000.

Ground at Cairo, Ill., has been leased for a planing mill and flooring factory by Charles Sands, D. C. Spencer and S. B. Spencer, and the firm name will be the Sands-Spencer Lumber Company.

The Glen Manufacturing Company, composed of New Castle and Ellwood City (Pa.) capitalists, has been organized to manufacture steel and wire novelties. A plant is to be erected at Ellwood.

The Waterbury (Conn.) Machine Company will erect an addition, 146x35 feet, for an erecting shop, also a 50x30-foot office building. A 10-ton electric traveling crane will be installed in the former.

At Glendale, in the Borough of Queens, New York city, a four story factory, 250 feet long, to cost over $125,000, will be erected by the National Enameling & Stamping Company, of Manhattan Borough.

Ground has been broken at Cowansville, Pa., for a brick manufacturing plant, to cost $50,000. William McDonald, of Punxsutawney, and brick manufacturers of Big Run and Dubois are interested.

A new plant is to be built for the John Davis Company, manufacturer of plumbers' supplies, etc., Chicago. The part first to be constructed will be a machine shop, 248x148 feet, to cost $42,000.

A permit has been issued in Jacksonville, Fla., to the Florida Cotton Oil Company for the construction of a refinery building. The company expects to manufacture soap as a part of the business.

A. J. Raymond, sash and blind manufacturer, is contemplating improvements at his Athol center (Mass) shop. He is to build a new engine-house, install a new engine and build a 65-foot chimney.

The F. K. Stevens Company, knitter of hosiery and underwear, has purchased from the Chicago Heights Land Association a one-story building, 75x200 feet, and will erect another one-story, 60x175 feet.

A proposition is on foot at Shawano, Wis., to form a $20,000 stock company to put up a mill and elevator. To this end the Advancement Association has appointed a committee, prominent in which is A. Kuckuk.

C. H. Campbell, of Charlotte, N. C., representing Col. D. A. Tompkins, who holds the franchise for water-works and electric lights at Tuscumbia, Ala., has been there to make arrangements for the proposed plant.

The Ryberg Machine Company, made up of Brockton (Mass.) men, will start business in that city soon. N. B. Lally is one of the prime movers. The company will manufacture a new power Rand cutting machine.

Work has begun on the construction at Elm Grove, W. Va., of a new manufacturing plant for a concern which we understand is the Heating, Ventilating & Foundry Company, now having a plant at Lazearville, W. Va.

The McDonald Grain & Milling Company, composed of Chicago capitalists, has bought a parcel of land at San Francisco as a site for a plant. It is understood that A. S. Baldwin acted as agent in making the purchase.

McKenzie & Diamond, boiler makers, Elwood, Ind., have found necessary to enlarge their plant. In the next few weeks a stock company may be formed to control the industry and double the capacity of the works.

The main building of the United Pump & Supply Company, Toledo, O., will be 80x200 feet. The plant will employ about 200 men. The company will manufacture farming implements, pumps, windmills, gasoline engines, etc.

The Betts Machine Company, Wilmington, Del., is making improvements to the plant on Maryland avenue. The erecting shop is to be doubled. The company has ordered a 20-ton crane, which will be put up in this department.

The Colton Manufacturing Company, saddlery hardware, Montpelier, Vt., has torn down an old building, with the view of erecting an addition to the foundry. Just when this addition will be built has not been determined.

The contract has been let for an addition, 70x124 feet, to the factory at Kingston, N. Y., of the Peckham Manufacturing Company, manufacturer of car trucks, New York city. It will be used for the manufacture of springs for trucks.

There is a project to establish a new elevator manufacturing plant, 350x150 feet, which Worcester, Mass., is trying to secure. F. A. Jones, formerly with the Plunger Elevator Company, of that place, is one of the promotors.

The concrete foundation has been completed for an addition to a machinery building of the L. S. Starrett Company, Athol, Mass., manufacturer of measuring instruments, machinists' tools, etc. Excavation for a new storehouse has begun.

It is stated at Pittsfield, Mass., that plans are on foot for the enlargement of the Jewell Storage Battery Company's plant, and that a new corporation, composed of Boston capitalists, is to buy the rights for the manufacture and sale of the goods in New England.

The Business Men's Club, Ironton, O., is trying to secure an engine manufacturing plant for that city. Thomas L. Collett, secretary of the club, is one of those engaged in obtaining stock subscriptions. The plant is understood to be now in operation elsewhere.

A new plant at the West End, Bridgeport, Conn., has been finished for the Eaton, Cole & Burnham Company, manufacturer of valves, fittings, etc. Now the old building on Main and Water streets will be torn down and a new factory for the company built there also.

A plant of the American Brake Shoe & Foundry Company, in Chattanooga, Tenn., has been burned, but will be in operation in temporary quarters within a few days. The company is believed to have in mind considerable improvements to its works in the city.

The Bowdoin Paper Manufacturing Company, of Topsham, Me., will consider the enlargement of its plant this winter. In the spring it will branch out. Plans have been drawn for four mills—one at Lisbon Falls, one at Pejepscot, one at Topsham and one on Granny stream.

Permits for several buildings have been issued to the Winchester Repeating Arms Company, New Haven, Conn. One is to be 60x210 feet, five stories, to cost $81,000; another, three stories, 54x100 feet, to cost $25,000; another, 18x24 feet, two stories; another, 54x88 feet, one story.

The newly incorporated Power & Speed Regulator Company, Kalamazoo, Mich., will erect a factory, which may be running in part by November 1. The speed regulator is intended for machine tools and other machinery, automobiles, street cars, etc. It is the invention of a Mr. White, of Kalamazoo.

Plans have been prepared for an extension to the plant of the American Bridge Company, in Trenton, N. J. The present output is 3,000 tons per month, but with the addition the product will average 5,000 tons. A new mill is to be erected later, which will bring the output to 10,000 tons per month.

The Cedar Rapids (Ia.) Supply Company, handling the Aultman Company threshers, engines and machinery, will build at Lincoln, Neb., a branch office and warehouse, with a shop where rebuilding and repairing old machinery will be done. The parent house of this company is at Cedar Rapids, Ia. S. N. White is the manager at Lincoln.

It is reported that the organization of the East St. Louis (Ill.) Cotton Oil Mill Company by Fort Worth (Tex.) capital has been practically completed, and the building of a plant will commence January 1. The company will be chartered under the laws of Illinois and capitalized for $250,000. Winfield Scott will be president and M. E. Singleton, general manager.

The Consolidated Hame Company, of Sunapee and Andover, N. H., and the United Hame Company, of Buffalo, N. Y., have incorporated under the laws of New York, with a capital of $1,600,000 and will operate plants at Andover, Sunapee, Buffalo, Tell City, Ind., and Cincinnati, O. An addition of 100x40 feet, two stories high, is being built to the Sunapee branch.

The Globe Window Glass Company, capitalized at $250,000, will erect a plant in Toledo and in addition operate the Marshall plant at Findlay, O. Among the incorporators are C. E. B. Lamson, Irving B. Hiett, Milton Taylor, J. M. Skinner, John Stotoerg, William C. Gosline, Jr., and J. W. Florence, of Toledo; Edward T. Wells, of Dayton, and Albert W. Marshall, of Findlay.

The Pennsylvania Railroad has under construction two power plants at Altoona. The one at the upper shops will be 103x75 feet, equipped with five engines and five generators and an arc machine for lighting purposes. It will also contain two air compressors for operating the yard switches and signals. The car shop plant will be fitted up with four engines and four generators.

A new silk mill is to be erected on West Eleventh street, in West New York, N. J. The foundation is already completed. The builder is William H. Schmidt. The lessees are Messrs. Griffith, Herman and Le Bert de Bar. Mr. Griffith is a salesman for a Paterson silk mill, Mr. Herman a manager of a mill in Paterson, and Mr. Le Bert de Bar a manager of one in New York.

The Imperial Glucose & Starch Company is being organized under the laws of New Jersey, with a capital of $3,000,000. A few of the names and amounts thus far subscribed are: C. M. Warner, Syracuse, N. Y., $500,000; E. R. Chapman, New York city, $100,000; E. A. Shedd, Chicago, $200,000. The location of the plant has been fixed at South Chicago, on the Elgin, Joliet & Eastern Railroad.

The Valley Iron Company, recently organized in Birmingham, Ala., with a capital stock of $1,111,111, has commenced operations in earnest. The proposed new plant will be located at Nixon Station, Ala. Plans for building the furnace and coke ovens are being drawn in Pittsburgh, Pa. The furnace plant will have an output of 250 tons of pig iron per day. The coke ovens will have a capacity of 450 tons per day.

At Hunker Station, several miles south of Greensburg, Pa., on the Southwest Railway, a plant is being established by the Penn Valve & Fittings Company, capitalized at $20,000, for which a charter will likely be applied soon. The incorporators are John Poppinger, Daniel Leffler, J. S. Lowe, Geo. McMichael, O. O. Evans and about twenty others, and the line of goods to be manufactured will be valves, fittings, etc., analogous to that of the Kelly & Jones Company, of Greensburg, where most, if not all, of the leading spirits have been employed. Some of the equipment has already been purchased.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

For Sale—One 21 in. latest improved Gisholt lathe. Box 61, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book, "Dies and Diemaking," 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

Sublet part of hurry contracts to Industrial M. Co., Newark, N. J., or 608 Western ave., Lynn. Parts of machines and light mach'y.

Cheap: 20 horse-power gas engine; Fairbanks, Moorse & Co. make; also hangers and pulleys. The Caille Novelty Company, Windsor, Canada.

Castings and blueprints, 5 sizes boat and sta. 2-cycle gasoline engines; also completed engines; tested, successful. Hildreth Motor Co., Lansing, Mich.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears, catalog of small tools free. R. M. Clough, Tolland, Ct.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—Light machine work and special machinery to build to order, special tools, dies and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

Established reliable New York machinery house wishes to represent some manufacturing ing company; can send hustling technical man on the road and introduce the products thoroughly; highest references. Box 67, AM. M.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

For Sale at a Bargain—An established manufacturing business, suitable for any first-class machine shop; easily moved; will sell for less than cost of finished stock and throw in patterns, tools and material worth as much more; worth investigating. A., care AMERICAN MACHINIST.

Foundry for Sale.—Complete plant, in Syracuse, N. Y.; will make castings up to 30,000 lbs.; is adapted for general work; has traveling crane, two cupolas, blower, flasks, etc., and is ready to run; plenty of local work; low price and reasonable terms; also have large machine and boiler shops, same place. Wm. A. Reade & Co., 410 American Trust Bldg., Cleveland, Ohio.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Foreman patternmaker open for engagement. Box 90, AMERICAN MACHINIST.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Mechanical draftsman desires to change position. Box 65, AMER. MACHINIST.

A type writer expert would like a position as foreman or designer in his line. Box 68, AMERICAN MACHINIST.

Skilled mechanic and expert draftsman, a professional inventor, wants engagement. Box 22, AMERICAN MACHINIST.

Mechanical draftsman (Swede), technically graduated in Germany, desires position. Box 86, AMERICAN MACHINIST.

Mechanical draftsman, age 26, graduate, 6 years' office and shop experience, wants position. Box 87, AMERICAN MACHINIST.

Engineer wants position as superintendent of shop or superintendent on erection of machinery. Box 40, AMERICAN MACHINIST.

A skilled general machinist and engineer wants position with an engine concern, as erecting engineer on outside work. Box 79, AMERICAN MACHINIST.

Designer and draftsman of special and automatic machinery, jigs, fixtures, etc.: 9 years' board, 3 years' shop experience. Box 78, AMERICAN MACHINIST.

Situation wanted by an experienced machinist foreman; first-class tool and die maker; am at present foreman of a shop employing 50 men. Box 76, AMERICAN MACHINIST.

Marine engineer with 7 years' practical and 7 years' drawing-office experience, with good references, seeks employment as draftsman, or otherwise. Box 69, AMERICAN MACHINIST.

Mechanical man, large acquaintance, desires to represent good machinery line in Chicago; engine hoisting, transmission and conveying machinery or tools. Box 37, AM. M.

Young man studying correspondence course wants position as apprentice to acquire experience in mechanical drawing and engineering. Clarence Corr, Walton, Del. Co., N. Y.

General superintendent large shops, turning out engines, hoisting and electrical machinery, requires an opening paying $2,500; references unexceptionable. Box 64, AM. M.

An accountant and office man, practical shop experience, wishes position; charge of office in small concern, or as cost accountant, as-

sistant superintendent or salesman. Box 75, AMERICAN MACHINIST.

Designer, 29, technical graduate, wants permanent position; 9 years' experience; automatic machinery, printing presses, engines, pumps, automobiles. Box 89, AM. M.

First-class mechanic, wishing to make a change, wants position as superintendent or general foreman; well up on jigs, dies and fixtures; automatic screw machines a specialty. Box 88, AMERICAN MACHINIST.

Position as master mechanic, chief engineer of manufacturing plant, or an executive position; best of references as to character and qualifications; electrician, mechanic, etc.; state salary. Box 72, AMER. MACHINIST.

By live, up-to-date toolmaker in northern Pacific coast country; can give good reference as to ability to handle toolroom to advantage in plants producing medium and heavy work. Box 10, AMER. MACHINIST.

Young, energetic electric and mechanical civil engineer, graduated from Chalmers Technical High College, at Gothenburg, Sweden, wants position as draftsman or in workshop; several years' experience. Address S. K., 231 Union st., Brooklyn, N. Y.

A practical machinist of experience in the shop on different classes of work and tools and outside erecting work is open for an engagement and prefers outside erecting work; can furnish the best of reference as to character and ability. Box 50, AMER. MACH.

Mechanical engineer and draftsman wishes to change; technical education; large experience as foreman, master mechanic and superintendent manufacturing small and medium interchangeable machinery and fine steel instruments. Box 4, AMERICAN MACHINIST.

Machinery Salesman.—Position wanted by active man (29), "technical graduate," as traveling or N. Y. representative; extensive practical machine shop, drawing-room and commercial experience; excellent references; junior member A. S. M. E. Box 66, AM. M.

Position wanted as foreman of machine shop or master mechanic; experienced in building heavy marine, blowing and electric power plant engines; some experience in drawing room; good reference; vicinity of New York preferred. Address "Reliable," Box 70, A. M.

A thorough mechanic with wide experience on special and automatic machinery, tools for interchangeable parts and sheet metal work, seeks position of responsibility as superintendent or foreman; thorough, practical and energetic, a good manager and up to date in every way; references. Address Box 74, AM. M.

A young man, at present employed as superintendent of a large jobbing shop in the vicinity of New York, would like to connect with a manufacturing concern that can hold out good future prospects; such a one can obtain the services of an A1 man for a reasonable amount. J. F. M., care AM. MACH.

Mechanical engineer, technical graduate and expert designer, desires change; 8 years' experience as M. E., chief draftsman and superintendent, in power plant installation, power transmission, shop management and design of light, heavy and automatic machinery; best of references. Address Box 71, AM. MACH.

Position wanted by young electrical and mechanical civil engineer, graduated from Chalmers Technical High College, at Gothenburg, Sweden; 1 year's experience in testing of engines and measure instruments and 3 years' experience as draftsman. Address J. O., 1877, The Swedish Engineers' Club, 231 Union st., Brooklyn, N. Y.

Situation wanted, as superintendent preferred, by a young man who is accustomed to holding position of highest mechanical and business responsibilities; a practical expert, without superior, in developing and designing the highest class of both heavy and light machinery; 10 years in present place. Box 47, AMERICAN MACHINIST.

Position as superintendent or assistant to superintendent, by young man; first-class mechanic; 14 years' experience on small and medium and interchangeable work; very best executive ability; a hustler, with modern and up-to-date methods and able to reduce cost of production; very best references. Address Box 73, AMERICAN MACHINIST.

Managing engineer and commercial man, corporation business over million yearly, desires change; have excellent executive ability; wide experience; familiar with shop order systems and cost accounts; great head for following up detail; expert designer; a pusher; can keep peace among employees; correspondence solicited. Box 52, AMER. MACH.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACHINIST.

Help Wanted.

The Draftsman—Cleveland, O. A sample for 2c. stamp.

Machinists—Your designs for patents made by G. M. Mayer, Monadnock, Chicago.

Mechanical draftsman, familiar with passenger and freight elevator work. Box 42, AMERICAN MACHINIST.

Mechanical and structural draftsman; experienced technical graduates preferred. Box 71, Station B, Cleveland, Ohio.

Wanted—Non-union molders; good wages and steady employment. Address Ridgway Dynamo & Engine Company, Ridgway, Pa.

Young man wanted, accustomed to operating Tabor molding machine; state salary expected and experience. Box 83, AM. MACH.

Wanted—Draftsman on boiler and machinery; young man preferred. Address National Water Tube Boiler Co., New Brunswick, N. J.

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Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Troy File Works, Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Westmacott Co., J. M., Prov., R. I.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Pattern Works, Chicago, Ill.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Wks., Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Toledo Machine & Tool Co., Toledo, O.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Enginering Co., Philadelphia, Pa.
Moyer & Co., J. W., Phila., Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moyer & Co., J. W., Phila., Pa.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Mach. Tool Co., Cin., O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.

Lathes—*Continued*
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Gump & Co., A. W., Dayton, O.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Milling Attachments
Brown & Sharpe Mfg. Co., Providence, R. I.
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co. Philadelphia, Pa.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.
Wallace Supply Co., Chicago, Ill.

Oil Cups and Covers
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Prentiss Tool & Supply Co., New York.

Patterns, Metal
Great Eastern Metal Pattern Co., New York.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Engr. Wks., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Wks., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, O.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Elmes Engr. Wks., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry Co., Cleveland, O.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co. T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Gump & Co., A. W., Dayton, O.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Reade Mchry. Co., Cleveland, O.
Toledo Machine & Tool Co., Toledo, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Moyer & Co., J. W., Philadel., Pa.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding, Electric
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

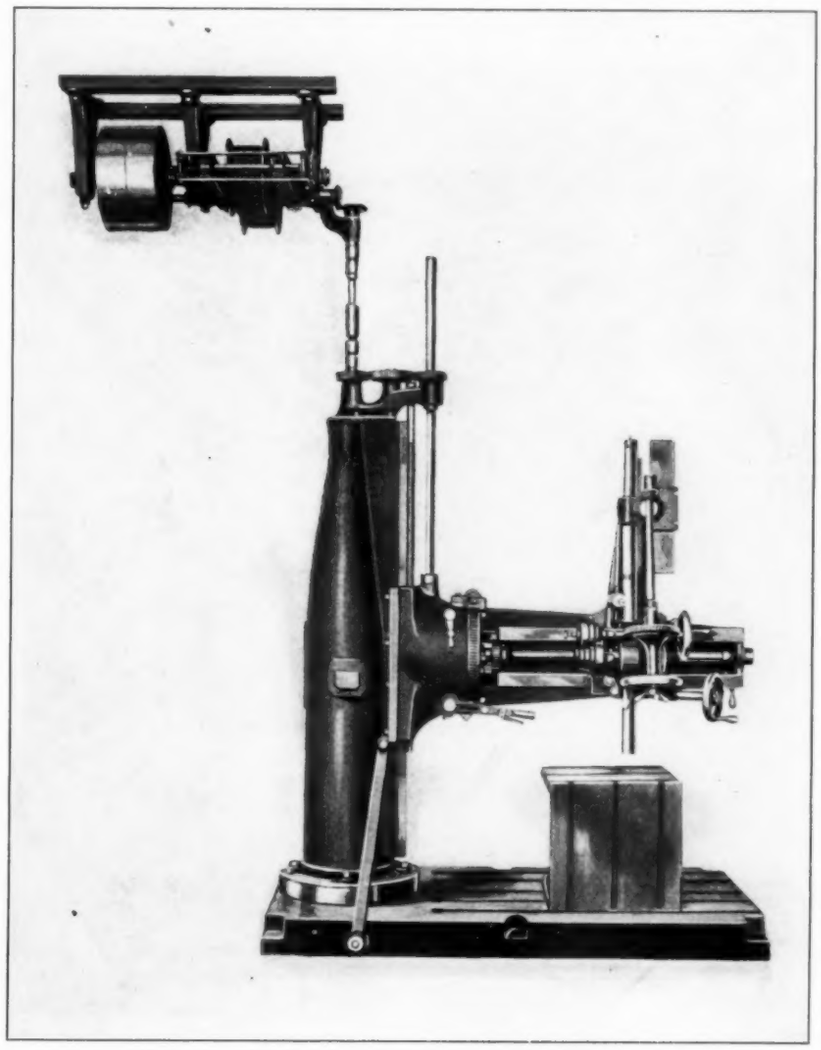
The New "Western" Radial Drill.

The accompanying half-tone illustrates a new universal radial drill which has been brought out by Hill, Clarke & Co., of Boston and Chicago.

The drive of the spindle is unusually direct and is applied to the lower end of the spindle at its largest diameter and near the work, thus largely reducing the spring of the spindle. The variation of speed will be seen to be by a Reeves variable speed countershaft, which is operated by a crank, and gives the entire range of speeds in four or five seconds, and the change of speed may obviously be made with the machine in motion as well as at rest. It is, in fact, so convenient as to permit slowing down while drilling through the scale of a casting and speeding up again when the scale is passed. The drive from the countershaft is by a vertical shaft which, however, is fitted with two universal joints, to obviate the necessity for extreme accuracy in alinement. When the machine is to be electrically driven the countershaft is mounted in a cradle at the top of the column and belted to a constant speed motor attached to a boss on the back of the column.

Four automatic feeds are provided, three of which are those recommended by twist-drill makers, while the fourth is extra fast for boring or reaming. The adjustment of these speeds is by the sliding push pin at the left of the upper conical feed gear case on the head. With this pin pushed in its full depth, the power feeds are disengaged and the hand feed becomes available.

The column casting is circular in section and double at the top. It swings completely around the circle and is supported on anti-friction bearings at both top and bottom. The hand lever at the base clamps the column with sufficient firmness for vertical drilling, while, as an additional security in horizontal or angular drilling, a number of bolts are provided in addition.



THE WESTERN UNIVERSAL RADIAL DRILL.

A test of the stiffness of the machine was recently made in the factory, the machine used being one of the five-foot size. A ¼-inch leading hole was first drilled in a block of steel and the tests were then conducted with a 2 7-16 inch twist drill following the ¼-inch drill. With the drill at rest and not touching the work, the distance between the base and the outer end of the arm was measured. With the drill head at the middle of the arm and at work, the distance was measured again.

With a feed of 160 turns per inch, or .0063 inch per turn, the movement of the end of the arm was found to be .013 inch. With a speed of 80 turns per inch, or .0125 inch per turn, the movement was .037 inch. These movements were, of course, the sum of the give in arm and column, as well as of the joints between carriage and arm, between arm and column and between column and base.

The convenience of operation is obvious from the half-tone, all levers and handwheels being within reach of the operator without changing his position. The raising and lowering of the arm are controlled by the same lever that operates the tapping attachment. The swiveling of the arm and drill carriage is by a wrench. The balancing of the spindle is especially neat. The counterweight has a rack cut upon it which meshes with hand feed pinion upon the opposite side from that engaging the spindle quill. The balance is obviously perfect, regardless of the inclination of the spindle.

Metric System in Great Britain.

Consul-General H. Clay Evans sends from London, August 30, 1902, a letter from the secretary of the Decimal Association, showing the progress of efforts to have the metric system of weights and measures adopted in England. The letter says:

"It has come to my knowledge that there is a considerable feeling in favor of the adoption of the metric weights and measures in the United States of America, and with this in mind I am sure that you will be interested in information regarding the prospect of this country adopting metric weights and measures also.

"I therefore venture to lay before you the following information: There are 290 members of the present House of Commons so thoroughly in accord with our aims that they have given me authority to publish their names as supporters. If we add to this the number of members of Parliament who would be influenced by a debate in the House of Commons to vote in our favor, we are convinced that we are now strong enough to carry a bill.

"During the last four or five weeks, no less than sixty city, town and county councils have passed resolutions to the effect that it is desirable that the reform should be made in the interest of commerce and education.

"One of the most definite results—in fact, I think I may say, the most definite result—of the conference of the colonial premiers was the passing of a resolution in favor of the adoption of the metric weights and measures throughout the British Empire. This will have a most important

result, and will render certain the early passing of a bill to give effect to those views.

"All the chambers of commerce in this country, nearly all the school boards, the trades unions, and a great number of societies of various kinds have for a long time been active supporters of my association.

"The attitude of our Premier may be gathered from some remarks he made to the deputation which waited upon him in regard to this question in 1895. He said:

" 'If I may express my own opinion upon the merits of the case, there can be no doubt whatever that the judgment of the whole civilized world, not excluding the countries which still adhere to the antiquated systems under which we suffer, has long decided that the metric system is the only rational system.' "

A King-Riedler Air Compressor of 1,000 Horse-Power.

The accompanying illustrations show a notable air compressor of which several have been furnished by the Fraser and Chalmers Chicago branch of the Allis-Chalmers Company to mines in South Africa and elsewhere.

In point of magnitude an engine of 1,000 horse-power is, of course, no longer notable, but an air compressor of that size is still noteworthy and will undoubtedly so remain for several years to come. This machine has, however, other features besides mere size to lend interest to it. Of these the chief are the King triangular connecting rod construction of the engine proper and the Riedler system of air valves. It is from these features that the compressor takes its type name.

Fig. 1 is a side view of one side of the machine—the complete compressor including two such sides, one at each end of the crankshaft with a flywheel between them. Fig. 2 is a side elevation. The high- and low-pressure steam cylinders, both of which are jacketed, are located respectively at *a* and *b*, the reheating intermediate receiver being between them at *c*. The high- and low-pressure air cylinders are immediately above at *d* and *e*. The crankshaft is at *f*, and it will be noticed at once that the steam cylinders are remarkably low—so low, in fact, that there is only room enough below them for the crank to turn in. This feature is the direct outgrowth of the King triangular connecting rod, and is, in fact, the chief point of advantage of the King construction. It is especially valuable in an air compressor. A vertical engine of the usual type is at best a lofty structure, but if air cylinders with intermediate distance pieces are to be mounted on top of the steam cylinders, the hight becomes fairly formidable. So effective is the King construction in reducing this hight that, in the case of the present machine, the ratio of length to diameter of cylinder is even greater than in many horizontal engines. The steam cylinders are 22 and 44x60 and the air cylinders 28 and 44x60 inches.

Examining Fig. 2, the piston rods will be seen to be fitted to cross-heads at *g* and *h*, short connecting rods *g i* and *h j* connecting the cross-heads to the triangular connecting rod *i j k*, which, at the end *k*, connects with and drives the crank. A bridle link *l m* constrains the motion of the connecting rod and completes the mechanism. A photographic view of the connecting rod is given in Fig. 3.

The relative motions of pistons and crankshaft are of course entirely different with this linkage from what they are with the usual construction. Because of this difference the usual eccentric construction as a means of operating the valves would entirely fail. Were the motion carried back to the valves in this manner they would find the pistons moving by an entirely inappropriate law and the movement of pistons and valves would not harmonize at all.

The valves are therefore driven by a motion similar to that with which the crank is driven, and, moreover, as the two pistons are connected to one crank, so the valves for both cylinders are driven by one eccentric—although the steam and exhaust valves have separate eccentrics. The eccentric is used for the reason that it always is—to obtain a short throw from a large shaft—and, as in the usual case, the size of the eccentric somewhat obscures the motion which it gives. Fig. 4 shows the construction of the eccentric and strap, the mechanism being, so far as movements are concerned, a reduction to scale of the crank mechanism. The center of the eccentric, corresponding to the crank-pin center, is at *a;* the eccentric-rod pins corresponding to the connecting-rod pins are at *b c*, and the bridle link pin is at *d*. The bridle link is at *n*, Fig. 2. The eccentric rods are of course much longer than the corresponding connecting rods and the motion of the valves is thus slightly modified from that of the pistons. This modification is, however, present in all engines and is much smaller with this construction than with the one commonly used. The vibration of the short main rods is so slight that the modification is, in fact, microscopic.

The necessity for reflecting the crank motion to a reduced scale for the valve motion exists also in the indicator motion, which is shown in Fig. 5, from which it will be seen to be combined in a very neat

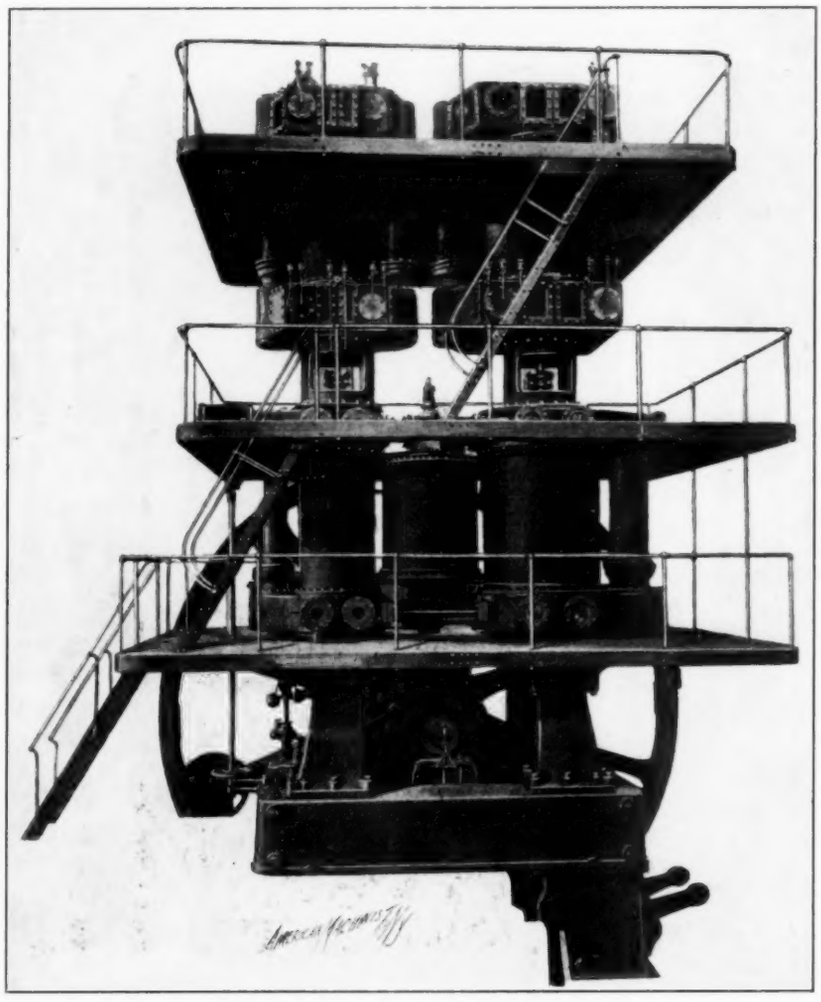


FIG. 1. SIDE VIEW OF VERTICAL KING-RIEDLER AIR COMPRESSOR.

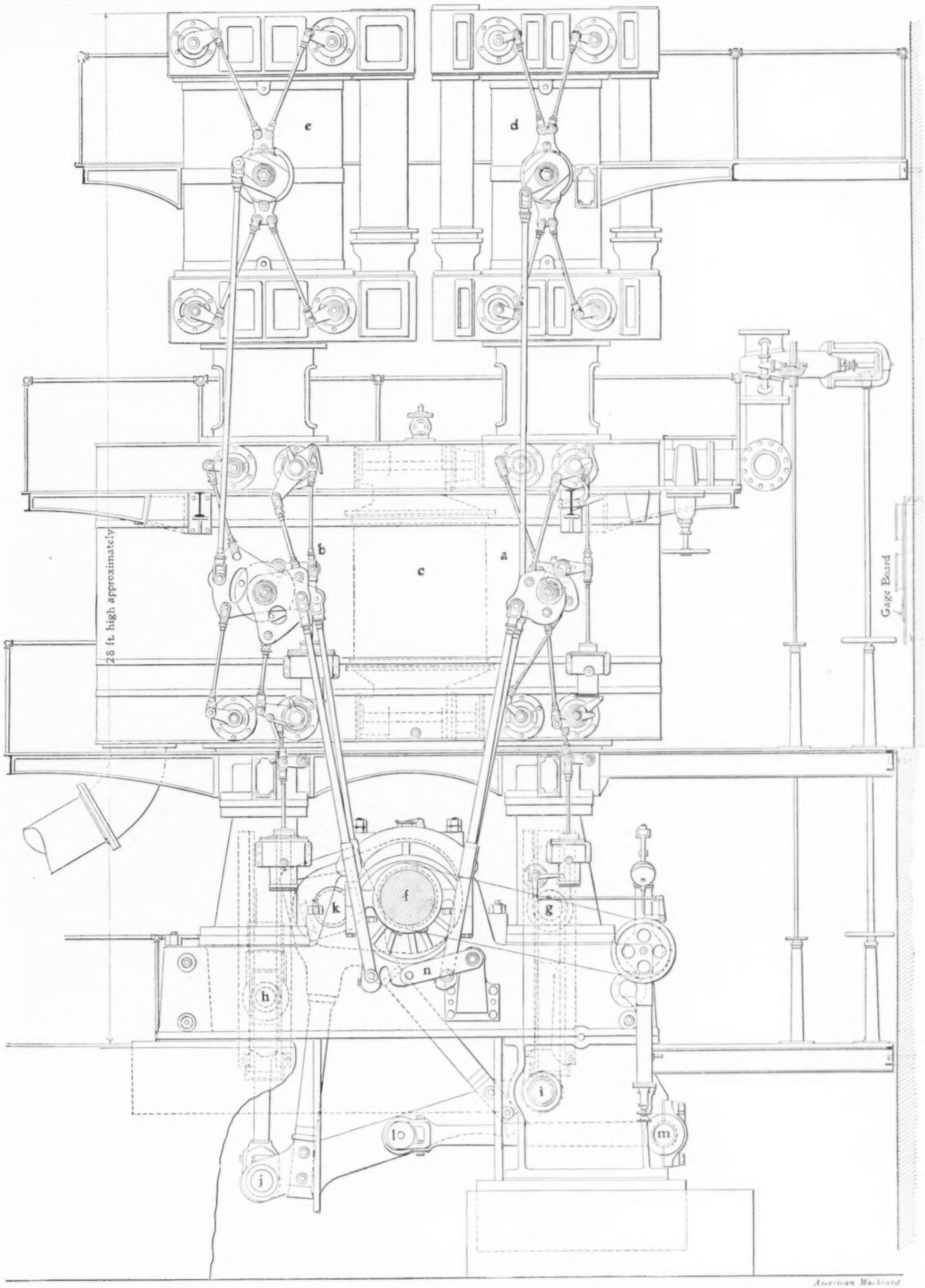


FIG. 2. SIDE ELEVATION OF 1,000 HORSE-POWER KING-RIEDLER AIR COMPRESSOR.

way with the centrifugal crank-pin oiler. A light hollow return crank *a* drives a hollow shaft *b* supported by the stand *c*, on which is mounted the oil cup—the oil finding its way to the center of the shaft through suitable openings. Shaft *b* has a short crank *d* on its outer side which drives a triangle *e e e*, the bridle link being at *f*. The indicator cords *g h* are attached as shown.

The general appearance of the external valve gear is shown in Fig. 6. The Riedler valves form a system of which the Fraser and Chalmers works have made a specialty for several years—applying them to both pumping and air-compressing engines.*

The special feature of this system of valves is that while they are closed positively by mechanism they are opened by the air or water, as the case may be. A moving lever closes the valve, which is of the poppet type, at the end of the stroke, and then, before the time for the valve to open arrives again, the lever withdraws and leaves the valve free to open whenever the conditions require it. The action is the same with both suction and discharge valve, and much of the mechanism is common to both. Both sets of valves require closing at the same moment—at the extreme end of the stroke—and since that is all that the mechanism does, the same movement is obviously as appropriate to one as to the other.

Fig. 7 is a plan section of the air cylinders, the section being taken through the upper valve chest. At *a a* are the suction valves and at *b b* the delivery valves, while *c, d, c, d* are the rockshafts and *e, f, e, f* the levers attached thereto which close the valves. Fig. 8 is a longitudinal section of the upper end of the low-pressure air cylinder and its valves, the surrounding casing being broken away. The valves will be seen to be double seated, the direction of the air currents being shown by the arrows. The manner in which the levers *a b* act to close the valves will be apparent on inspection. At *c d* are air gag or choke pots, the office of which is to prevent any rebound of the valves from the stops which limit their opening when the compressor is running at high speed. The valves of the high-pressure cylinder are similar to those of the low except that they are single seated.

Fig. 9 shows the method of operating the valve rockshafts and levers. A wrist-plate *a* is driven from the eccentric motion through the pin *b*. The wrist-plate carries cams *c d* which act at the ends of the stroke to reciprocate the sliding piece *e* vertically through a short range of motion. Piece *e* carries pins *f f*, which, through connecting rods *g g*, oscillate the crank arms *h h*. The crank arms are in turn keyed to the rockshafts, which extend through stuffing-boxes to the interior of the valve case and operate the valve levers *a b*, of Fig. 8. Additional pins *i i* on the upper ends of the sliding piece *e* operate in the same manner to control the movement of the valves at the upper end of the cylinder.

*A high-pressure hydraulic service pumping engine with this system of valves by the same builders, was described at pages 773 and 793, Vol. 21.

Echoes from the Oil Country.

VARIOUS EXAMPLES—HOW HAVE YOU FOUND IT?

We used to hear unpleasant remarks when I was a boy about the chap that was "Jack of all trades and master of none," and he was held up as a horrible example, often by those who were not even good "Jacks" at anything.

While very few are likely to know it all about anything, a little outside knowledge about all sorts of things often helps right in the lines where you want to know the most.

I understood (for I had been told so by men who had worked for years at the business) that the trade I had started to learn was the poorest of all trades, that the men who wrote books treating on it were mostly fellows that couldn't hold a job in any shop, that the company had to furnish all the tools except a couple of pairs of calipers (two-for's) and a scale, and that the fellow who spent his money and got a lot of tools so that the company could have the advantage of them was a "chump," that thinking was the boss's job and that it was well to let him have it all to do—it kept him from watching some folks too close, that the trade was getting worse and worse, so that by the time I had my time served it would be worse than having been a laborer. While these things were drilled into me strongly by some, there were men who had nice tools and tool boxes and who got good pay and read books and thought a little once in a while, and they had a way of somehow getting the best jobs in the shops or often bossing jobs *where they did not have to work*.

Once a friend asked my advice about taking a bossing job. As it carried better pay than he was receiving, I encouraged him to take it if he thought he could do

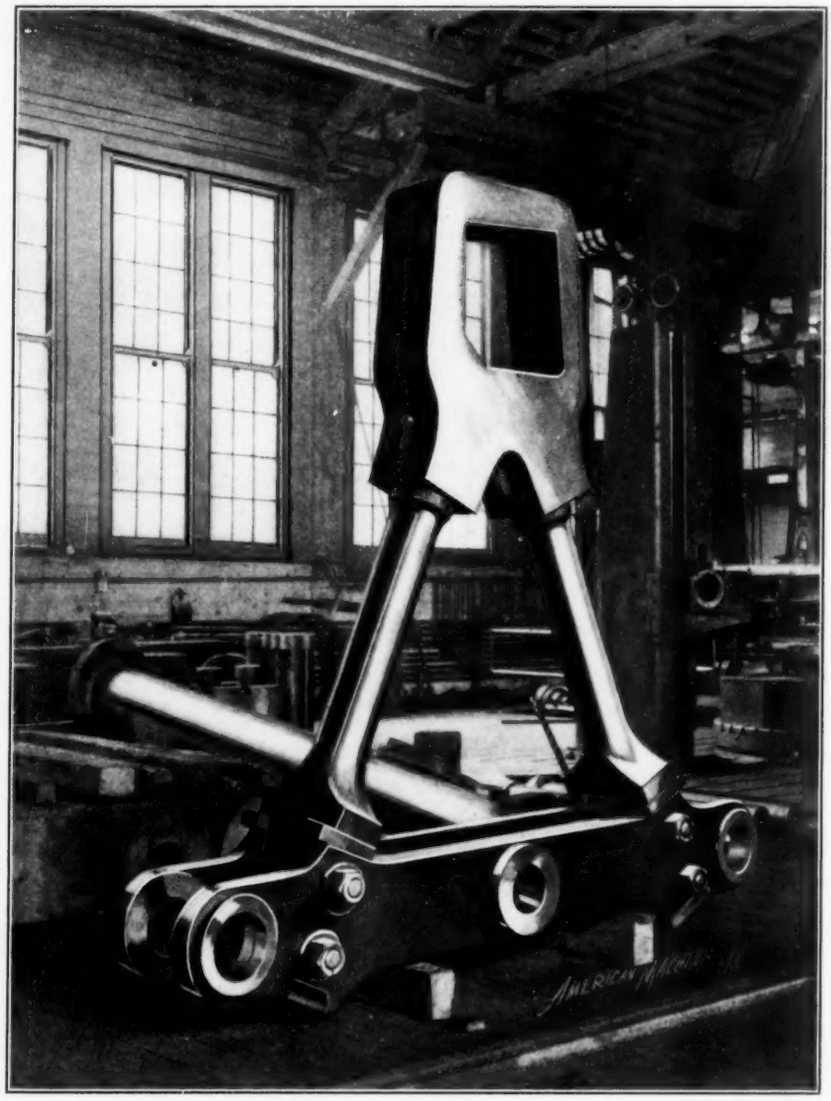


FIG. 3. THE KING TRIANGULAR CONNECTING ROD.

the work and please the owners, but I added: "But don't you think for a minute you will have a soft snap. I have stood around many a day with my hands in my pockets and never done a thing but talk, and gone home tireder than any man on the job." "Is that so?" the other asked, rather skeptically, "I wouldn't think it."

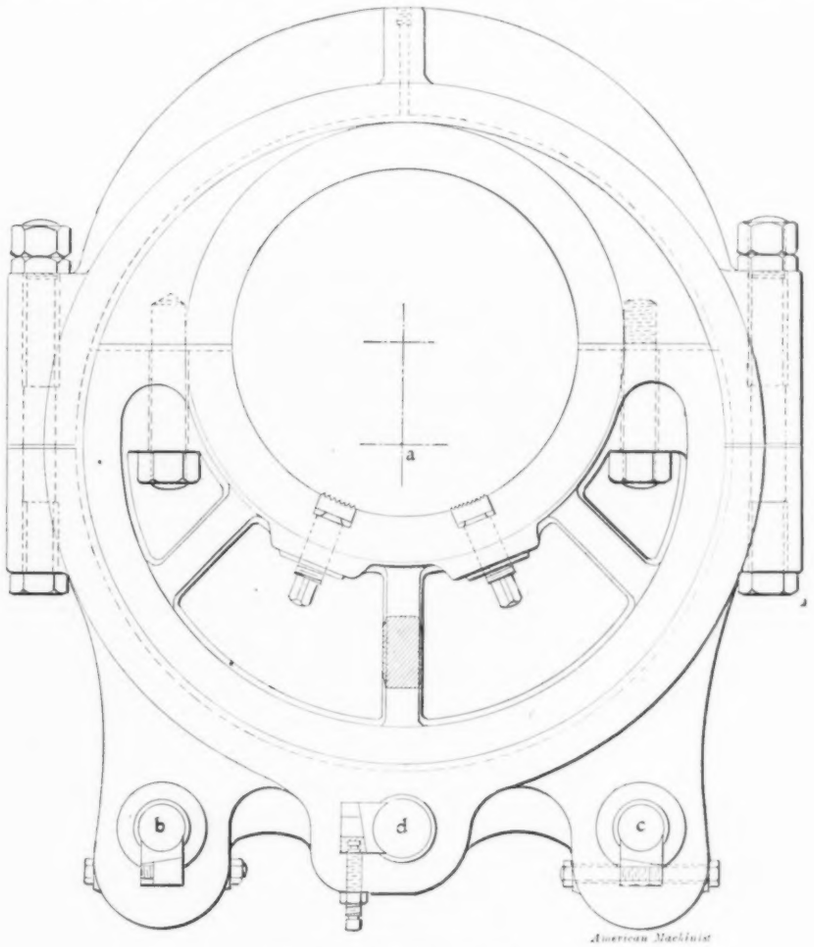


FIG. 4. ECCENTRIC AND STRAP.

He took the job and several months afterward I met him and inquired:

"How do you like being boss by this time?"

"The pay is the nicest thing about it; a fellow has a whole lot to look after. When the men ain't after him the office is."

"How do you seem to fill the bill?" I asked.

"I hardly know. They haven't chased me off yet, but that is all the encouragement I have had so far. If I get anything just right they don't waste any time telling me about it, but I get it proper if anything is a little off."

"You don't seem to have fattened up any yet," said I. "Do you ever get tired?"

"Tired! I never knew what it was to get tired before. I get so tired it wakes me up in the night. It seems funny, but I get tired all over and don't seem to get rested like I used to. I didn't used to think a fellow could get so tired without *working*."

I saw a few days ago the fellow who used to tell me about the miserable trade. He was looking for work and incidentally he told me that work was not what it used to be *because the boys and laborers were doing it now in all the big shops*. I certainly would dislike to spend years acquiring that little knowledge and skill.

Some folks must be born lucky, else how did that boy who used to buy tools and read books and papers ever get to be the head of an "engineering works." I don't think there was a boy in the shop that couldn't beat him at cards or checkers, and there wasn't any fun in him. He never had a good time smearing up someone's lathe or throwing stuff, or "sogering" on the boss.

Ben was a great fellow for fun. Ben

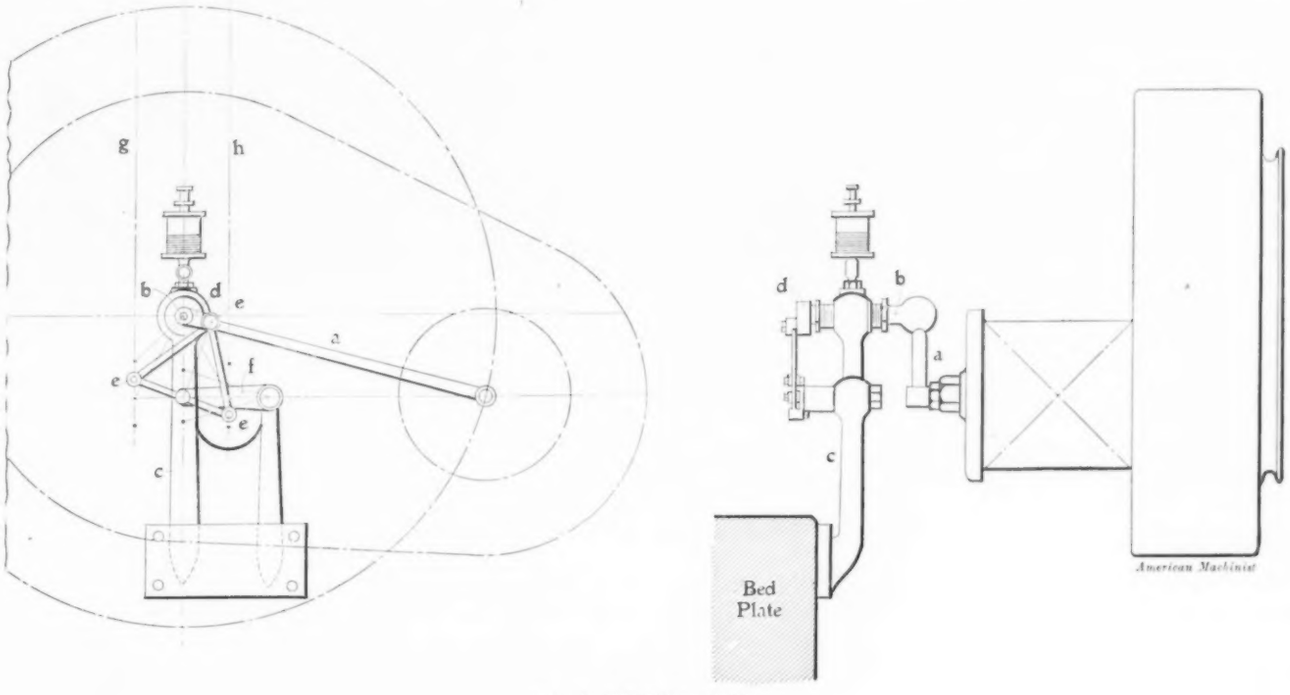


FIG. 5. INDICATOR GEAR.

was a helper, and a good one. Sam was altogether too solemn, so Ben undertook to wake him up. It wasn't very hard to rig up a pail of dirty wash water over the door of the room where Sam worked and fix it in such a way that it would turn over when anyone opened the door.

Sam was at the other end of the works just then, and his return was looked for with interest. The superintendent came in. "Ben, go into Sam's room and get that valve that is on the bench and take it to the engineer; hurry up, now."

The eyes of the room were on Ben, also the superintendent was waiting. Jobs were not very plenty. Like a hero Ben marched up and opened the door and his claim to being a natural mechanic was justified. The lump caused by the pail may have caused his stupidity while the superintendent was trying to find out who put the pail there, for he certainly seemed unable to say anything intelligible. Perhaps it has something to do with his still being a helper; anyhow, it's hard to get an old dog to learn new tricks even with dirty water, and even if self-education does have the name of going deep.

Surely those two boys are interested in some profound investigation, and being apprentices they feel somewhat justified in using company time and stock. Not wishing to be hindered, they work at odd times when the boss is busy at other places; some bosses are very unreasonable. They can't be expected to do very much or very good work with their time taken up between their great project and watching the boss. By and by they get that squirt gun done, and not long after one of them gets a pretty severe shaking up from one of the men and the boys are minus their plaything.

"Yes, I learned my trade in the same shop that John did, but the boss never gave me a show. There was just certain ones that got all the good work and the best machines."

Of course! Of course! Foolish boss to let such talent and willingness lie around unemployed. I wonder what that squirt gun cost?

Dan was busy for quite a while with something. When he had a cut on, he would draw mysterious designs on the top of his tool box; then he began using paper, and finally he cut out some paper and pasteboard forms and would pin them down and watch them as he moved them in various ways. Just as solemn as an owl. The boys left Dan alone. I don't know how many evenings it took him to make some sketches of his idea, and the company he worked for did not care to use it. Their opinion of Dan was not lowered by his offer to them, and the $300 another firm paid for the idea would buy several pretty good squirt guns.

He was a new boy and didn't know the value of things and so came for advice.

"A fellow wants to sell these to me for a quarter. What do you think they cost?" And he held up a pair of loose-jointed, home-made calipers.

"It is hard to tell exactly, but as they are made of steel forged from a large piece and seemed to have been used quite a bit, I would guess they cost the companies anywhere from $5 to $500, and they may have cost their owner much more, although reputation and opportunity are held very cheap by some men. Out in the woods, with necessity driving, make tools of wire, lath, strings, nails, pins or anything else that will help you out, but don't do it in the shop unless you get results with your makeshifts that are better or quicker than those obtained with the regular tools. While those calipers *cost* a great deal, they are not *worth* anything. Really they are positively a minus quantity. Don't take them as a gift. You might not have nerve enough to throw them away."

A man once worked near me that had a well-filled tool chest of home-made tools. I never saw him do any work for himself noon hours or evenings, yet those tools represented many hours of hard work. I wonder which one really lost the most on them, the man or the company?

Looking around among those who started with me, I find that most of them received such pay as their efforts deserved. Why should the sullen "grouchy" fellow expect the men and the boss to go out of their way to do him a favor, or the shiftless, indifferent, careless one expect to get nice, important work, or the one that had to be shown every move expect to be sent out on repair work where he must do all the thinking for himself?

Men are somewhat more apt to help along a pleasant, cheerful, willing boy who is ready to give them a hand without grumbling than they are a "smart Aleck" and a "kicker." I guess most of us know these things and can see plainly why the other fellow doesn't get along better. The one who expects to get something for nothing generally gets left. W. OSBORNE.

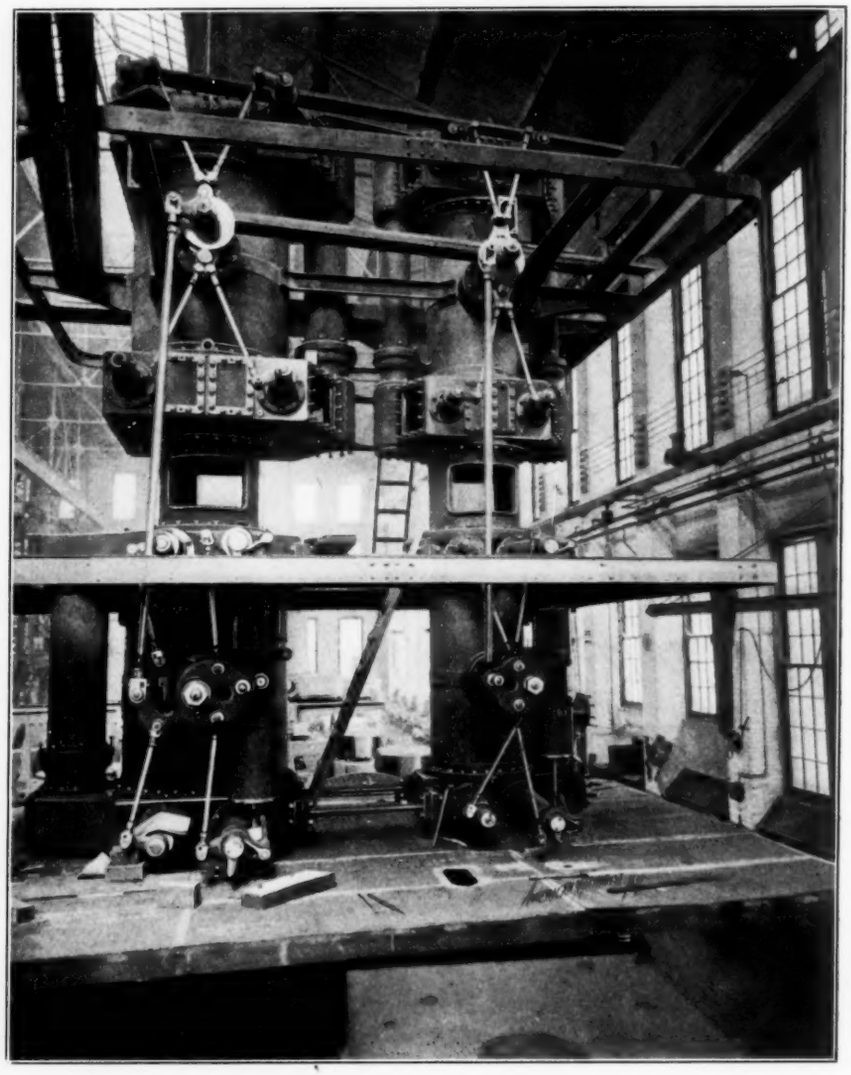


FIG. 6. CYLINDERS AND VALVE GEAR.

Novel Shop Construction.

The Wheeler & Wilson Company have found it necessary to enlarge their works, and the *Sewing Machine Times* gives us an interesting account of the manner of construction. The company's property, of six blocks, is now so well covered that extensions of buildings must be upward, and the new structure, three stories high, is replacing a section of the one-story building, 450 feet long, on Barnum avenue. About half this length is now in progress, the concrete walls and steel frame being well up. The company is doing this by day's work, the uninterrupted work of the department being of first importance and an objection to any contractor's undertaking it. While the alterations are substantially finished they have been made without the necessity of moving a single machine, or the loss of a day by any workman. The old walls were of brick and were entirely removed. The new walls are of the natural gray of Portland cement, of which the concrete is composed in proportion of one to six of sand and gravel. The piers between the windows are 12 inches thick, the panels below the windows are 8 inches. The windows are high and in double-width, providing for unusually good light. Flooring and roof are of improved mill construction, and in all respects the building is of best modern de-

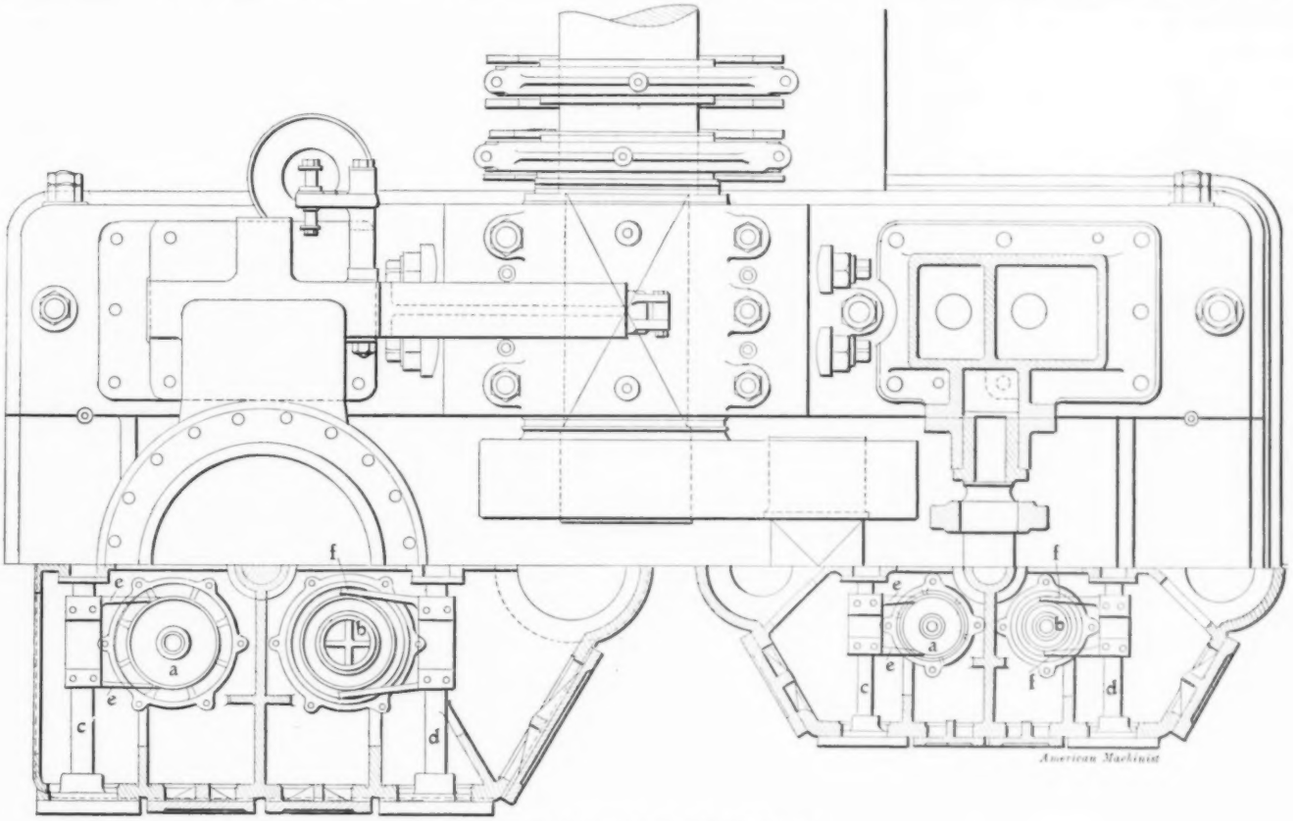


FIG. 7. PLAN SECTION OF AIR CYLINDERS.

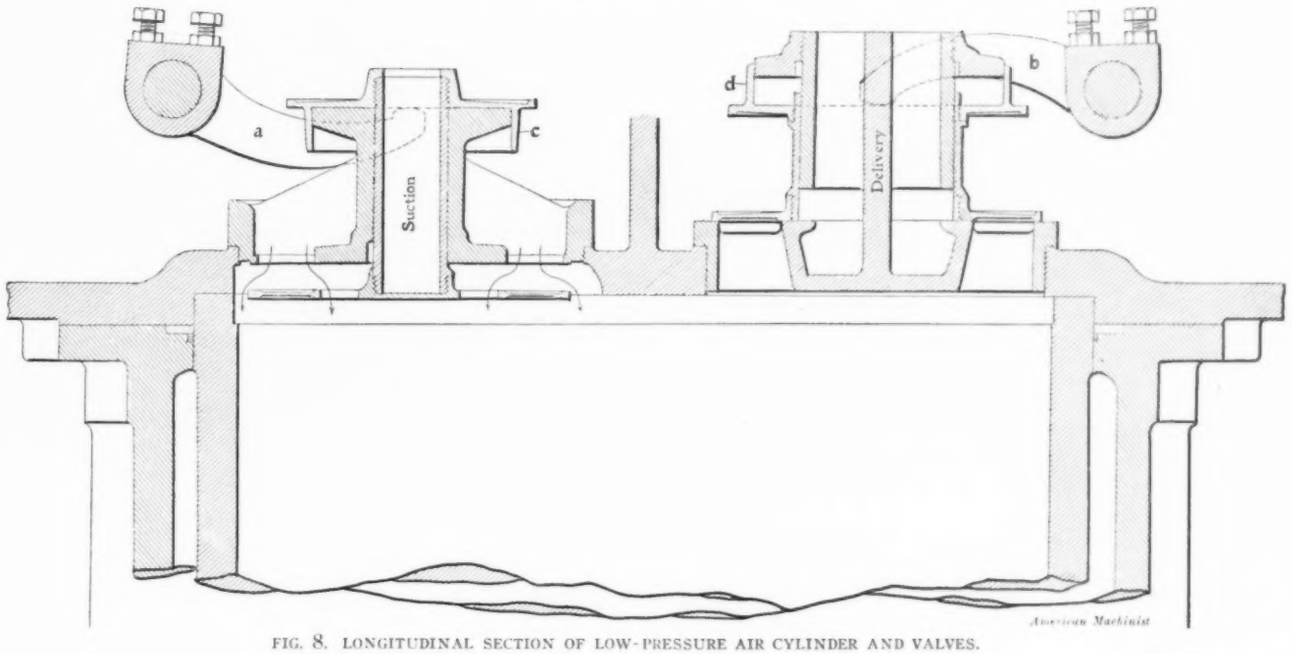


FIG. 8. LONGITUDINAL SECTION OF LOW-PRESSURE AIR CYLINDER AND VALVES.

sign. The second section will not be started till this is finished and occupied. The manner of constructing the concrete walls is interesting though very simple. Window frames are set, a mold is placed around the space between or below, and the concrete is poured into the mold. It sets in twenty-four hours and the mold is removed.

Smoke Abolition.

BY T. T. PARKER.

I have read with pleasure the vigorous article of W. H. Booth on smoke suppression at page 1169. Being a boilerman, I want to offer my thanks to Mr. Booth for his words. He calls a certain garden utensil a spade, and his article is full of assertiveness on the subject. In the war that is being waged on smoke in our large cities, such words reaching foremen, superintendents and managers should open their eyes and dispel their skepticism on the subject. Men engaged in operating factories as a rule look closely after the economical production of their wares, but do not regard their steam plants as experimental laboratories and are deeply tinged with doubt on the smoke question.

Mr. Booth appears to think the water-tube boiler the leading boiler of this country, in which he is in error. The standard American boiler for stationary purposes is the horizontal tubular type so common as to require no description. Mr. Booth is certainly correct in saying the water-tube, as ordinarily set, is a vile smoker. Fortunately, we are on to this fact, and the chain grate, with its brick arch over the fresh fired fuel and its proper air admission, shows excellent results as a non-smoker, and in fuel economy.

In a recent installation of four water-tube boilers in a large Chicago office building—The Rookery—the boilers were set with extension furnaces—that is, the grates were placed directly in front of the boilers and thus room was allowed for a brick arch over the grates—the firing being done by hand. Excellent results were produced and no smoke resulted, save while heating up a cold arch. However, as the water-tube fellows have the problem solved for those who care to buy a non-smoking water-tube, we can let them fight their own battles.

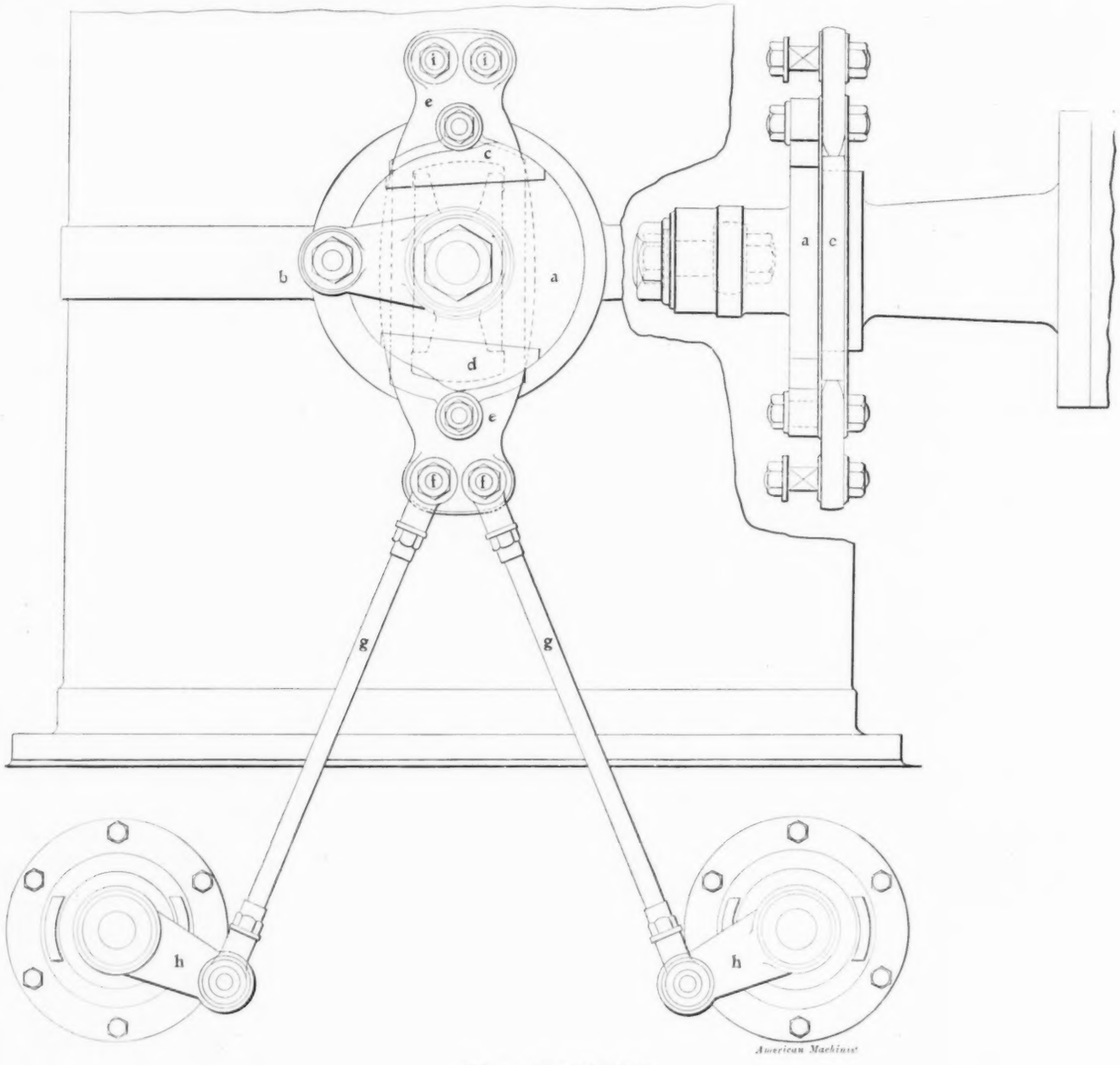


FIG. 9. AIR VALVE GEAR.

The boiler of the internally fired type is getting a following in this country, although it is doubtful if it will displace either the plain tubular or the water-tube. Experience has shown it to be a smoker, due, as Mr. Booth says, to the flue arches being relatively so much colder than the

heat required for combustion. It strikes me that an extension furnace will settle this trouble by completing combustion before reaching the flue—not tubes. One party has proposed a fire-brick arch in the flues, but the experiment has not yet been tried. Dismissing then the water-tube and the internally fired boilers, let us take up the question of smoke in the horizontal tubular boilers.

What is being done, what can be done, without too great cost and without sacrificing fuel economy to render this boiler a non-smoker? I beg to say right here that I neither buy nor sell boilers or furnaces, being an insurance boiler inspector only, so I can speak without indirectly offering any wares to the public. In the first place, it is necessary to secure the hearty co-operation of the fireman, for he can change a non-smoker into a smoker. We must get his pride aroused, get him to try to avoid smoking by alternately firing each door, as by light and frequent firing very much can be done by this method, though it is more active work for him. Assume we have, say, two boilers, 60"x 16', the grate surface being ample but not too much for the load. Assume we are evaporating from 3 to 3½ pounds for every square foot of heating surface per hour. What now can be done to change the boiler into a non-smoker without buying any patented furnace? If we have sufficient room to spare, we can remove the front, set it forward, say, 6 feet, and build a fire-brick arch, as shown in Fig. 1, running just under the front boiler head back to the fire doors, placing the grates of course under this arch and providing for air admission over the grates with openings that permit easy adjustment. The brick arch should have a drop as it runs forward, say, 1 inch in a 5-foot run, for the purpose of compelling the flame to strike it fairly. The arch should be built of key brick and be set pointing lengthwise to the grates, using very little mortar. The curve of the arch should be all that can be given it, and note that dropping the arch will thus aid in giving clearance to the doors opening into the front head. With such a furnace it is clear that with decent firemen combustion is completed before the gases or the flames strike the shell. Also note that a volume of cold air does not strike the shell and tubes during firing, as this furnace holds the temperatures very even—a valuable result. Such furnaces have been in use for years, tanneries in particular using very large ones to burn wet tanbark. Any decent mason should be able to make it up.

If we have not room to spare for the above, there are other ways. We can make the bridge wall 3 feet thick and cut it down to 8 inches above the gates. Then on the top of the bridge wall we erect at equal distances from the side walls two pieces each, say, 15 inches high. At this level, cut into the side walls, and from a side wall to a pier, and across them place arches, as shown in Figs. 2 and 3. We may buy large special fire-brick in place of arches, brick 24x5x10 inches, and use them, but the arches do as well. I should advise that these arches be 3 feet long, thus giving better results in longer travel of the gases through them. Over the top of them lay loosely, without mortar, even brick up to the shell.

In the common settings, please observe, it is not practicable to place an arch extending from one side wall to the other over the grates, as not enough room is usually provided to give such an arch crown enough to hold it up. No doubt by lifting the boiler, say, 18 inches to 2 feet, we could do this as in an extension furnace; usually this will not be done with existing boilers, and the arches at the bridge wall are the next best expedient. The next thing is to put in a steam jet. Take a piece of ½-inch pipe, weld one end shut, bulging and rounding that end at the same time to a semi-circle, as shown in Fig. 4. With a thin hacksaw cut in four or five slots *A*, so that the steam in escaping covers the most of the grates. Outside, put on a quick-opening valve to admit or cut off by hand. Of course, the average man will now start in

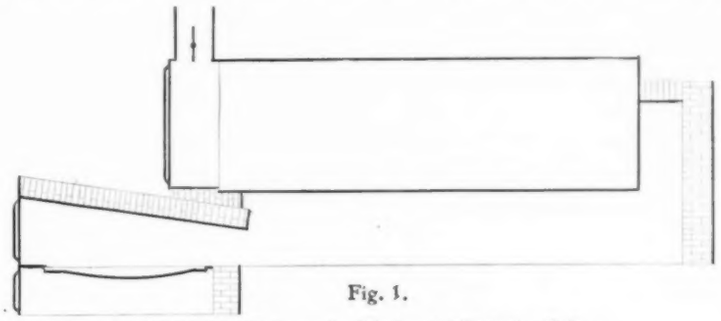


Fig. 1.

Extension Furnace for Horizontal Tubular Boiler.

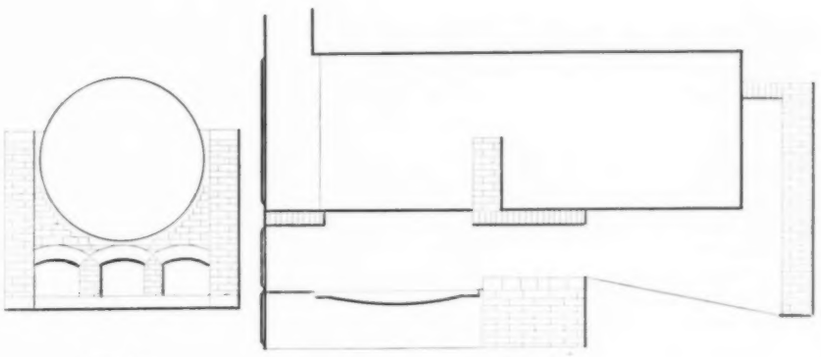


Fig. 2. Fig. 3.

Fire Brick Arches at the Bridge Wall.

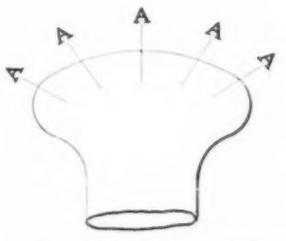


Fig. 4 Steam Jet made from ½ or ¾ inch Pipe.

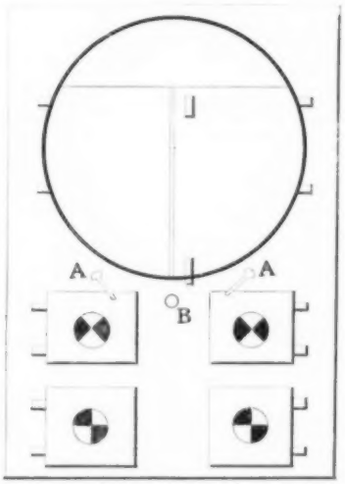


Fig. 5 Location of Steam Jet and of Rods for Controlling Fire Doors.

American Machinist

THE PREVENTION OF SMOKE FROM STEAM BOILERS.

of his own accord to rig up some automatic device to open and shut this valve. If he does not, someone will, and then patent it. It will be a dash-pot, etc., all right, but anyway put on a quick-opening valve. Next comes the air admission above the grates. Usually the dash-pot aforesaid will close the air admission at the proper time; but if not, drill a hole in the front, bend a piece of ½-inch round iron, so that the door will strike it and not entirely close. The location of these rods is shown at *A* and the location of the steam jet at *B*, Fig. 5. These rods can be placed so that they can be thrown out or in to give any desired opening found best, and they will not cost much. The only objection to this furnace is the cold shell over the grates, which chill the gases before combustion is complete, and also in getting up steam. The first effect is constant, the second is not and may be waived.

We must now, having given these aids to the fireman, secure his careful co-operation. Anybody can shovel coal, and the common idea of lots of otherwise sensible men is that anybody who can shovel coal is a fireman—not by four rows of apple trees! It is like laying brick—looks easy, but try it a day and see your wall. A good fireman has learned ways and means like the brick mason. Get a good one and pay him wages to make him content. He will graduate into the engine-room after a while, but he will train another one when he does. He will fire lightly, alternating from door to door. With such a furnace, smoking can be stopped. I personally know many boilers thus equipped which are non-smokers.

Of course, there are many furnaces on the market that give good results, but observe the man at the shovel is necessary with them just the same. I am not exploiting any patent furnace, nor am I throwing bricks at any, but just trying to aid some people who want to stop smoking and really do not know what to try or buy, and perhaps do not have much money to spend, anyway.

Arches as described are cheap and should last a year at least. It will be found necessary to clean out the ash, so as not to allow choking up under the arches. A series of pigeon-hole brickwork does well also, but as the openings are small they require frequent cleaning. I saw two boilers the other day, with a series of piers directly behind the bridge wall (which was low), the space between the piers being 6 inches. It was claimed to be all right with a jet. The stack showed up clean and he had not had a "call" or fine since he put them on.

While one could write a book on this subject, yet, as no one else seems to suggest anything, it occurred to me that some ideas along this line might prove an aid to the people whom Mr. Booth's article may have hit. I have offered simple inexpensive changes that give others good results in small plants. In large plants where fuel economy is sought, more money would be required to install furnaces that are for sale; but with the devices described there will be no loss in fuel nor in power obtained.

Some Details of the Card Index System in the Purchasing Department.

BY F. H. LELAND.

The article describing a card-index system for the running of the purchasing department, which appeared in the columns of the AMERICAN MACHINIST at page 1306, Vol. 24, has brought forth numerous letters of inquiry concerning features in the application of the system, which were not discussed in the published article.

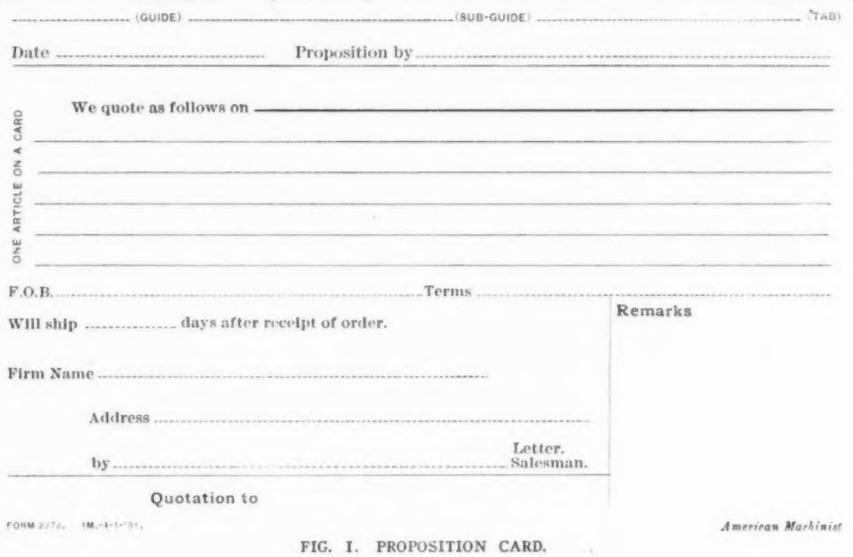


FIG. 1. PROPOSITION CARD.

Some of these inquiries appear to be of general interest and are replied to as follows:

By your system, how does the purchasing agent know with whom to place his first order for a new sort of material?

The use of a two-drawer *Quotation Cabinet* covers this point. One of the drawers of this cabinet is devoted to miscellaneous items and is divided by master index guide cards alphabetically, these alphabetical master card divisions being sub-divided by tab cards as required.

The other drawer is divided by master guide cards into the various kinds of material, *Castings, Sheet, Rod,* etc., and each *kind* of material is again divided by tab cards into its various sub-divisions, *Iron, Brass, Copper,* etc. Thus it will be seen that these two drawers are divided in precisely the same manner as are the drawers of the cabinet described in the first article.

When the purchasing agent is required

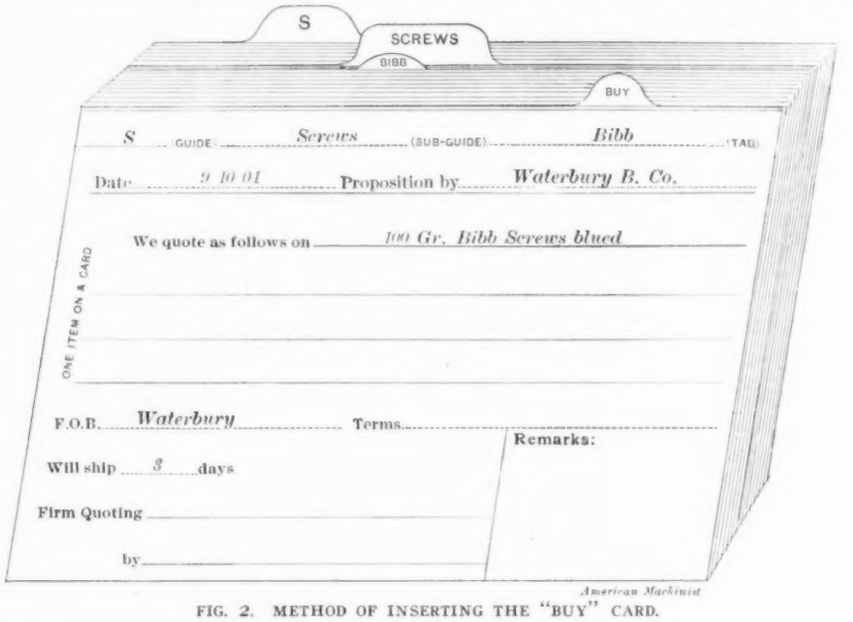


FIG. 2. METHOD OF INSERTING THE "BUY" CARD.

to buy material not before used, say 100 gross of bibb screws, he will write to the various manufacturers of bibb screws, as given, for instance, in any of the commercial directories, and on receiving replies from the various vendors, he or his assistant transfers the information contained

in these letters to proposition cards, one form of which is shown in Fig. 1. These proposition cards are filed in their proper place in the *Quotation Cabinet*, in this instance in the miscellaneous drawer under the master guide *S* and under the sub-guide *Screws*, they being again tab-divided *Bibb*. Different colored guides are used for each subdivision.

When ready to place his order for the 100 gross of bibb screws the purchasing agent consults his proposition cards, and the vendor who has made the most favorable proposition gets the order.

Having accepted the favored vendor's proposition and picked his quotation card from the others, a red tab card marked *Buy*, Fig. 2, is thrown in immediately back of the accepted vendor's proposition card. This is done so that when checking invoices it is not necessary to go through the whole number of proposition cards in order to find the one wanted.

The original letters from which the proposition cards are made out are filed in the general office files or in a *Current Quotation* file which is kept in the purchasing department. They are preferably filed in the latter place.

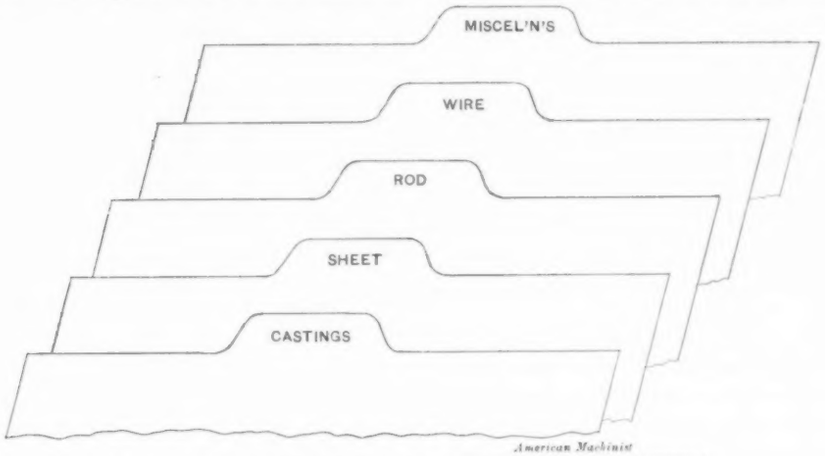


FIG. 3. MASTER GUIDE CARDS FOR VARIOUS KINDS OF MATERIAL.

Is any distinction made between in-town and out-of-town orders?

A color distinction is made. Town or city order blanks are of one color, and out of town or foreign orders are of a different color. The wording of the forms is the same in both cases except that the word *shipment* is used on foreign orders, while the word *delivery* is used on city orders.

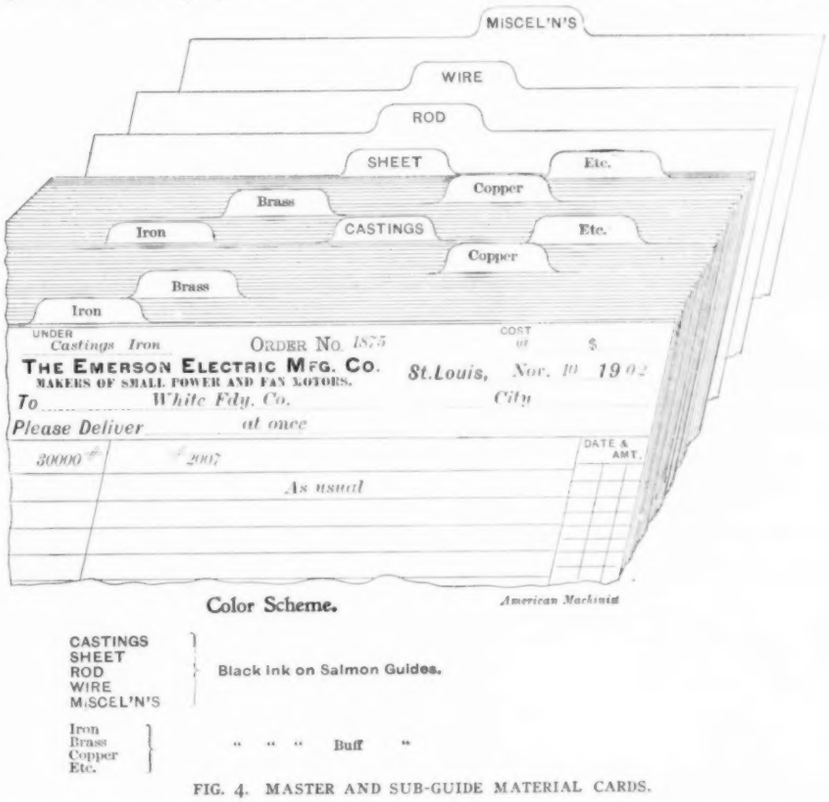


FIG. 4. MASTER AND SUB-GUIDE MATERIAL CARDS.

Is the price at which an order is placed left off of the order ticket intentionally or through error? If intentionally, why cannot the house from whom the material is ordered later on ask for higher prices? Would it not be better for the order ticket to state the price at which the order is given?

The price is left off of the order ticket purposely, and for two reasons: First, it is customary to buy most material at a contract price, in which case there is no need of specifying price every time material is ordered forward on a contract already placed. Second, material not bought on contract is bought on the market, so that it is not advisable to state the price in the order, because if the price was stated and a decline in the market took place before the order was shipped by the vendor, the purchaser would not receive the benefit of the decline in price, and if the price advanced the vendor would be obliged to correspond with the purchaser regarding the price, and the delivery of the material ordered would be delayed. This would of course be fatal to any factory output which was dependent upon the prompt receipt of material ordered. Also it is the custom among houses of integrity to notify their customers of the approach of an advance and in many cases to protect their customers against such advances.

There is, however, no objection to writing in on the face of the order any stipulated price at which it is placed.

It will be noted that on the record card a place is provided in which to record the price at which the material is billed, this being considered important in checking future invoices and as a matter of reference. It will be remembered that this record card bears the permanent records of the transaction and never leaves the purchasing department.

Are the order blocks bound and perforated, or simply glued together?

They are glued together. If they were blocked and perforated the record cards would be ragged on one edge when torn off from the perforated block. Uneven cards are a great annoyance in permanent files, and to avoid this the order forms are blocked and glued, and they are glued at side (preferably the left side) so that the tops may be smooth and even to admit of rapid handling in the drawers.

What do you consider to be a good-sized card to use in your purchasing department card-index system?

Many things considered, a 5x8-inch card is the most practicable in the majority of cases.

How would a card system such as you describe handle a transaction which is very complicated. For instance, suppose that instead of ordering 600 pounds of No. 22 H. H. sheet brass and having it all come in one shipment, the buyer had to order at the same time 600 pounds of No. 21, and 1,000 pounds of No. 20, and perhaps a dozen other different items. Would he have to make out a separate order card for

each item, or would he have to put them all on one card? If the latter, it would seriously mar the completeness of his records when the transactions were all ended, but if the former it would necessitate the making of a separate order for each item of perhaps a very long list. That is to say, if it were twenty-five items of sheet brass, wire, etc., all to be ordered of the Bridgeport Brass Company, all to be shipped November 1, by fast freight, it would mean writing the words "The Bridgeport Brass Company, Nov. 1, Fast Freight," twenty-five times. Suppose this had been done, and that you had a separate card for each item, but that the Bridgeport Brass Company, instead of shipping the 600 pounds on one date, divided the shipment, sending 300 pounds November 1 and 300 pounds a week later, their bill for the first 300 pounds would come in, and if the receiving clerk pasted the red ticket on to the invoice he would have no red ticket to paste on to invoices covering subsequent shipments. What is done in that case?

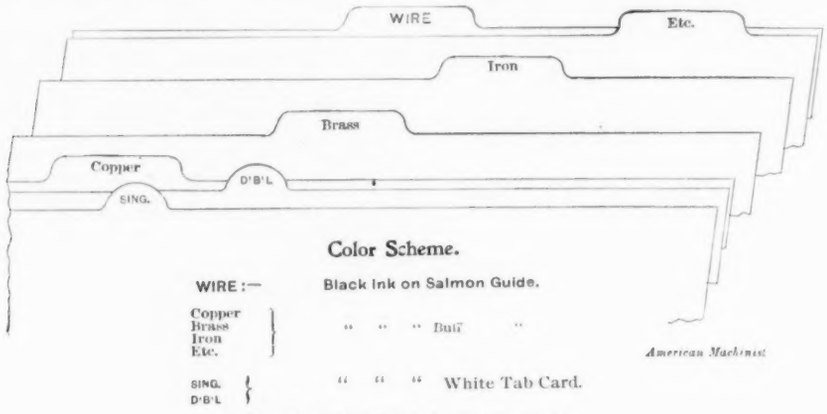


FIG. 5. TWO KINDS OF WIRE CARDS.

When ordering different sizes of material of the same kind, it is not necessary to write a separate order card for each kind. About three sizes of one *kind* may go on one order card; this will leave room to enter receipt of partial or total deliveries as they are received. If it is thought probable that all the items of one kind ordered can be sent from stock in one shipment, the order card may be filled full, one item (size) on a line. It is, however, better practice not to fill up an order too full, but rather to leave a line or two blank than to in any way crowd the records.

If there are twenty-five items of sheet brass, wire, nails, screws, etc., to be ordered from the Bridgeport Brass Company, all to be received November 1 and all to be shipped fast freight, you would divide the various items into *kinds* of material, *Castings, Rod, Sheet, Wire, Miscellaneous,* and subdivide each kind of material as follows:

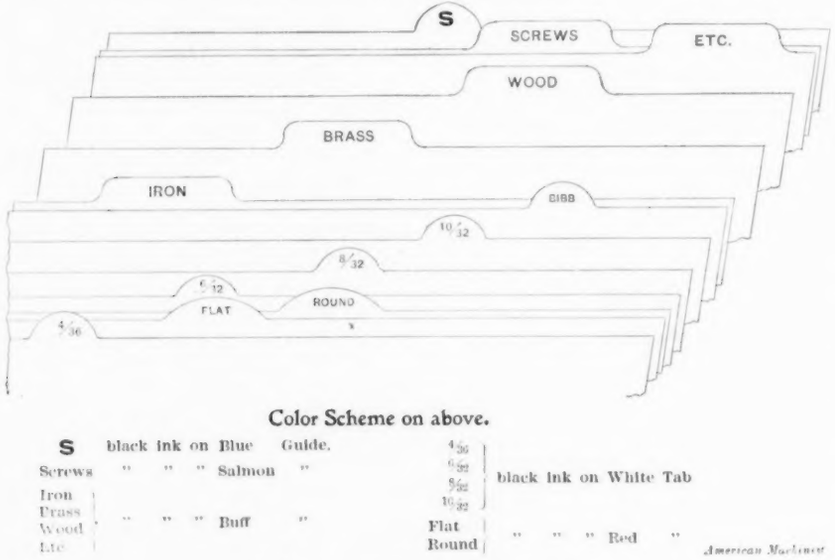


FIG. 6. COMPLETE INDEX FOR SCREWS.

CASTING.	SHEET.	ROD.
Brass,	Brass,	———
Iron,	Iron,	———
Copper,	Copper,	———
Etc.	Etc.	

The length to which the subdividing is carried varies with every establishment, and further varies with the quantities of material required for a year's output of completed product.

The key to the success of the whole plan is in the proper indexing by guide, sub-guide and tab cards. The writer has found the above division to be very satisfactory for use in a manufacturing establishment.

For example, be it required to order the following list of items:

600 lbs. No. 22 H. H. Sheet Brass.
600 lbs. No. 21 H. H. Sheet Brass.
6 0 lbs. No. 20 H. H. Sheet Brass.
100 Gs. 1¼ H. H. $\frac{10}{32}$ R. H. I. M. S.
1000 lbs. No. 13 Double Cotton Mag. Wire.
900 lbs. No. 20 Double Cotton Mag. Wire.
1500 lbs. No. 14 Single Cotton Mag. Wire.
100 doz. $\frac{8}{32}$ Card taps.

First label one drawer of the cabinet *Ordered* and into this drawer place center master guides, lettering them according to the various kinds of material which they are to cover, Fig. 3.

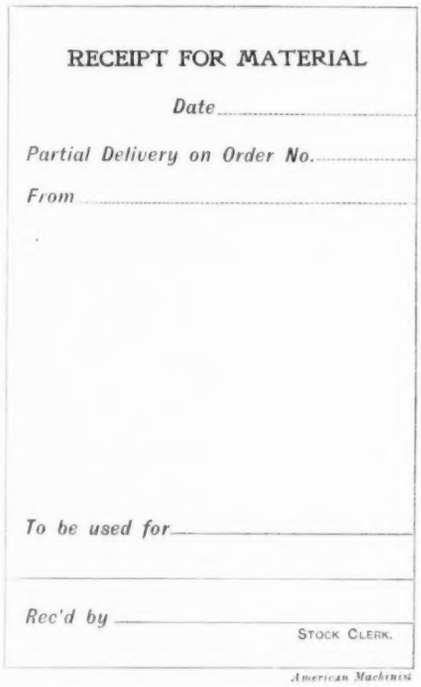


FIG. 7. PARTIAL RECEIPT SLIPS.

In front of these master guides, place subguides of a different color (but all of the same color), these subguides being classifications of the various kinds of material under the master classification, Fig. 4.

Now, from the list of items, take those for sheet brass and enter about three items on one order; this will leave sufficient space to enter receipt of the brass in two shipments for each size, which is sufficient for the quantities named in case the shipper does not happen to have enough stock on hand of the sizes ordered to make a complete delivery in his first shipment.

Order the magnet wire in the same manner, only do not order double and single covered on the same ticket, because, while it is all copper wire, still there are two kinds and they are handled as separate items by both shipping and receiving clerks, so that to put both kinds, double

and single covered, on an order card causes confusion and also invites error on the part of the stock boys who file and put away the order.

The two kinds of wire record cards are filed separately by placing a tab card in front of the general guide card, Fig. 5.

When there are many sizes and several kinds of one material, as is usually the case with screws, the subdividing tabs are more numerous. It is often found to be convenient to index screw orders, as shown in sketch 6, the order cards being made out in similar manner as were those for the magnet wire.

Whether screws shall be indexed according to the style of their heads, *Flat, Round,* etc., or by size only, depends entirely upon how many of a single size are used. If only a few sizes are used, index by style of head. On the other hand, if many sizes are used, index by sizes, and where both sizes and styles are used in quantity, the complete indexing shown in Fig. 6 may well be adopted.

All miscellaneous items are master guid-

FILE UNDER *Sheet brass* ORDER NO.

COST at 15 1/10 $

THE EMERSON ELECTRIC MFG. CO.
MAKERS OF SMALL POWER AND FAN MOTORS.

St. Louis, Oct. 1 1902.

To Bridgeport Brass Co. Bridgeport, Conn.

Please Ship Nov. 1 Via fast frt.

					DATE	AND NO. DEL'D	
600	22	HH	Sheet Brass				
				22	10/30	200	O
600	22	HH	Sheet Brass	22	11/4	400	O
				20	10/30	400	O
					11/4	200	O

American Machinist

FIG. 8. THE RECORD CARD.

ed alphabetically, and whether items are miscellaneous or not depends on the quantity or number of kinds used. If only a few of any given articles are used, call them *Miscellaneous.* If the article in question is used in some appreciable quantities, index records pertaining to it subjectively under the proper classification. In the sample order I would index the taps under *T* in the miscellaneous drawer, and if later on enough taps are used to warrant doing so, throw in tab cards to show the size of the tap in the same manner as was done with the screws.

In indexing record cards, each new classification should be shown by a different color tab, thereby greatly facilitating accurate and rapid handling of the cards.

This color scheme can be easily carried out on the tabs by buying them all cut from white stock in different sizes and then coloring the tab projection by dipping in colored inks as the cards are required for use.

In regard to ordering a large number of dissimilar items at one time, it is not advisable to do this, for the very simple reason that when too many dissimilar items are handled at once, sufficient care is not always taken of each of them, and it is very easy to arrange stock reports so that it is not necessary to order any large number of *dissimilar* items at one time. Rather orders for all items of the same kind can be taken up each day, so that one kind can be taken up, say, each day in the week. By so doing the ordering of each item of material will be given the full amount of attention which it deserves.

This is easily carried out in practice by having the stock clerk report on double covered magnet wire one day, on single covered the next day, and so on down the his list of items. This leaves only odd and end items to be cared for as they come along, and they, too, will be given their proper attention from the very fact that they are odds and ends and are conspicuous by coming up in an irregular manner.

Regarding the handling of partial deliveries on an order: The original red slip is used to handle the completing delivery only, the previous partial deliveries are received on the *Partial Receipt* slips, Fig. 7, which are printed in red ink on thin manila paper; these partial receipts being handled in the same manner as the red slip. The partial delivery is noted on the red slip and record card, and invoices are passed with the partial receipt slip attached to them in exactly the same manner as is outlined in the first published article.

The record cards are marked as shown in Fig. 8, and the invoices are passed through for payment, so that invoices for partial deliveries are handled through for payment in exactly the same manner as are invoices for complete delivery, the mark (X) on the record card being sufficient to indicate that the material has been received, prices and extensions O. K.'d and invoice audited for payment. The original red ticket is held by the receiving clerk until the completing delivery on material ordered is received, at which time he signs and returns the red ticket to the purchasing department. No *Partial Receipt* slip is used for the final delivery, as the red ticket itself serves as a receipt in full for material ordered on the given order number.

Letters From Practical Men.

Repairing a Planer Head Swivel Box.

Editor American Machinist:

We had a breakdown in one of our planer heads recently, and it was due to the new method that is being used by some planer makers.

The apron swivel-box center pin is made

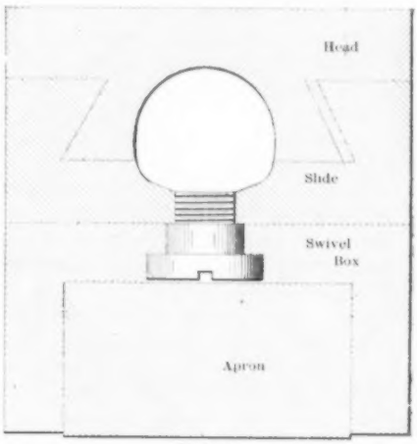


FIG. 1

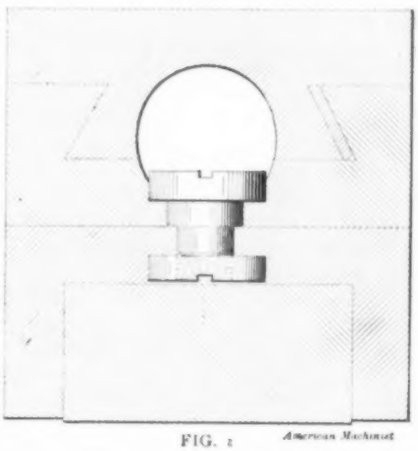


FIG. 2 American Machinist

REPAIRING A PLANER HEAD SWIVEL BOX.

1 inch diameter, has 14 threads per inch and has only ½ inch of thread, which screws into the cast-iron slide. This stud, as shown in Fig. 1, bears most of the strain when the tool is cutting and was not long in wearing loose in the threaded hole, due to its small diameter and fine thread and very short bearing, and finally completely stripped the thread and smashed the swivel box.

Fig. 2 shows how we repaired the head, putting on a new box and making both stud and nut of steel.

The older, better method is to turn a

fair-sized boss on the back of the swivel box, and have it fit into a hole in the slide. The boss then takes the thrust and not the center pin, as Fig. 1. H. E. B.

Another Crooked Crankshaft.

Editor American Machinist:

Reading of the experiences of Messrs. Osborne and Hutchinson with crooked crankshafts calls to mind a job that I had with one, which, being wholly different from theirs, may be of interest to some, as theirs were of much interest to me.

At the time I was in charge of a small repair shop in connection with a large manufacturing establishment The plant had been burned and the engine had been installed only a few months before the fire. Upon deciding to rebuild the plant, the company sent the engine back to the builders for repairs. The shop was overrun with work, and as the engine was not to occupy a very high-toned position, they simply did what work was necessary to put it in good running order, regardless of appearances.

The shaft was of steel, 7½ inches diameter by probably 8 feet long, with a crank disk 30 inches or more in diameter. It was considerably sprung by some machinery falling on it while hot. After a liberal application of peening it still remained 1-16 inch "out." They then turned the bearings and faced the disk, in as far as the crank-pin, true with the bearings. The wheel also being sprung, they rebored it true with the rim and turned a bushing eccentric to correspond with the untruth of the shaft.

A templet of the bed and the distance between bearings had been sent in advance of the engine, and a machinist who had been setting up engines a good part of his lifetime set the anchor rods and had the foundation all ready when the engine arrived. All went well until he was ready to place the shaft in its boxes, when he found the tail box the breadth of itself, or 16 inches, too close.

Here was a dilemma that was a lot easier to get into than it was to get out of, and the situation was anything but pleasant for the machinist. Fortunately there was room for the box in that position; but how to get a bearing on the shaft for it was altogether another question, and when I happened in I found a thoroughly disgusted machinist surveying an innocent-looking box and dividing his time between wondering how he ever got the thing that way and how he was going to get that bearing turned.

As the shop that built the engine was the one he had left to accept his present position, he had neither the time nor the inclination to send the shaft back there to await its turn to have a bearing turned, and he said, "I don't see any other way out of it except to file it. The disk is too large for your lathe to swing, and besides the shaft is too long for your centers."

It seemed to me a case where a little brain work might save a lot of bone labor and time, too, as filing 1-16 inch off one side of a 7½-inch shaft for a distance of 16 inches did not seem practicable, so I thought it over that evening and next morning I proposed the following plan and went at it.

We had a 24-inch lathe and I took the caps off the engine boxes, inverted them and blocked them up on the lathe bed until they were the proper hight and placed the shaft in them with the disk hanging over the end of the lathe. The shaft did not reach the face-plate by about 30 inches, but a piece of cast-iron pipe with a flange on each end, taken out of the scrap pile, just filled the space nicely. A couple of holes drilled and tapped into the end of the shaft, with cap screws through the flange into them, and the other flange bolted to the face-plate made a very satisfactory drive. Both the screws and the bolts were left a little slack in order that they might form knuckle joints in case the shaft was not in exact line with the center line of lathe. With a suitable drive and true bearings thus provided, the turning of the 16 inches for a new journal was a simple matter. The result was a good job in a reasonably short time. L. J. E.

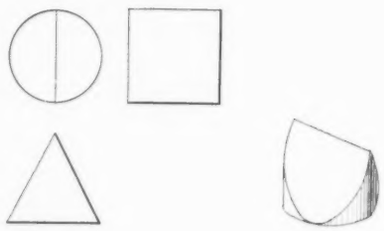


Fig. 1. Fig. 2.

AN OLD MECHANICAL PUZZLE.

A New Phase of Machine Design.

Editor American Machinist:

A correspondent at page 1345 smiles at the above editorial, and, as he proceeds with his description, he smiles again, until in the end I am smiling myself, which is a mighty good thing, as I was mad at first when he declared this "New Phase" was not practicable. This "New Phase" is really perspective drawing applied to machine design. Perspective is the most natural form of representation and, but for certain difficulties, it would be the universal method. It is not easy to execute, and figures do not attach themselves readily to such a drawing, but the greatest objection of all is that none of the parts can be scaled. I say it is the most natural method because I have noticed that when one not skilled in the art undertakes to make a mechanical drawing he usually attempts to combine perspective with his plan or his elevation. So also, in trying to make a plan myself, or in explaining it to others, I find myself making perspective sketches of the various parts, and I am convinced that the mind grasps them more fully in this form. Some people seem to be endowed with a sense which is denied to the rest of us, which enables them to see just how a piece is going to look when

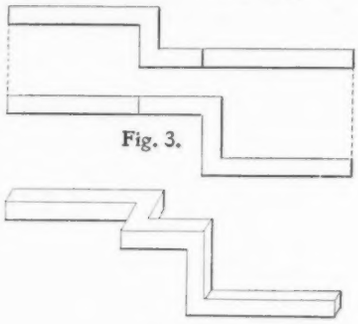


Fig. 3. Fig. 4.

A PUZZLE FOR THE BLACKSMITH.

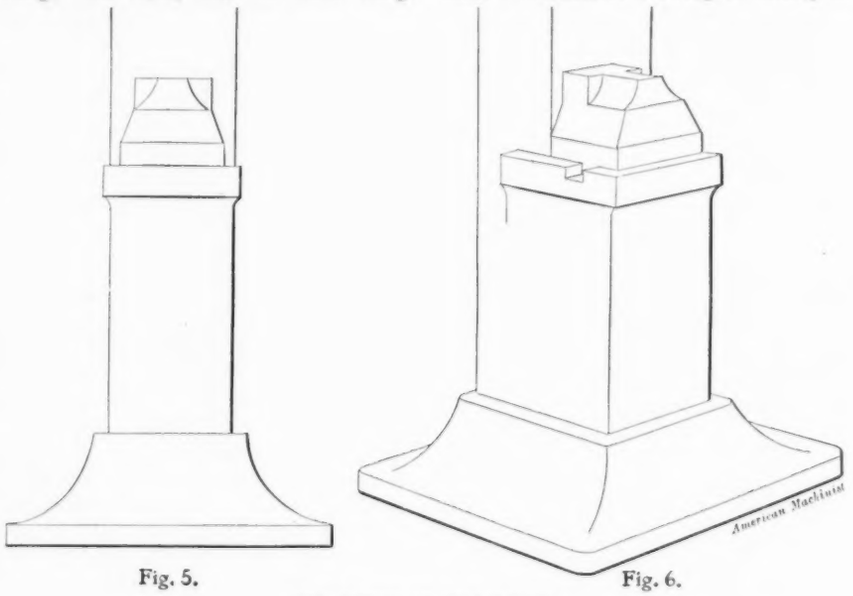


Fig. 5. Fig. 6.

THE EFFECT OF PERSPECTIVE.

finished. On the other hand, there are good mechanics to whom a plan means almost nothing, and who are able to work from one only by means of the "talk that goes with it." To such people a perspective sketch is so great a help as to justify the time spent in making it.

You will doubtless recall an old puzzle —"cut out a block of wood that will exactly fit a square, a round or a triangular hole.' These three holes are shown in Fig. 1 and a little reflection will show that these three figures represent also three views of the block of wood when completed. But even then it is a little difficult to mentally combine the three views so as to grasp the exact shape of the block, but when we see it in perspective, as shown in Fig. 2, it at once becomes plain enough. Of course some people will say that solving riddles is no part of a draftsman's duty and that this "funny business" is beneath the diginity of a designer, but any patternmaker will tell you that he has had just such blocks as this to whittle out, and he would have been mighty glad to have had someone solve the riddle for him. Take another illustration: Suppose we take a drawing like Fig. 3, properly dimensioned, to a blacksmith and ask him to make two forgings like the drawing. If we go off and leave him alone, the probabilities are that he will study over the drawing for a while, scratch his head, and end by forging two different pieces, one like each view! Now, a little in the way of a perspective drawing like Fig. 4 would go a long ways towards starting him right.

As I remember it, the AMERICAN MACHINIST claimed that in working up a perspective drawing so as to present a view as seen naturally by the eye, certain unexpected defects in proportion were disclosed. On the other hand, certain parts may look weak in the working drawings but seem to "fat up" in a perspective. Take, for instance, the base of a power hammer, shown in Fig. 5. This looks weak, thin, out of proportion, as shown in the elevation, but throw the same design into perspective and the eye is satisfied with the "new phase."

Architects and monumental designers understand this and allow for it in their work. A square tower on a building or a square die on a monument is sure to look larger in the perspective than in the elevation. A round column looks smaller because it is usually associated with a square base or cap, and as these appear larger the column seems smaller by contrast. As the perspective represents the work as it will appear when done, due concessions must be made for this peculiarity, and this was, doubtless, what the editor meant.

Of course the main object of a machine is to do work; beauty and symmetry and all outward appearances are secondary to this, yet of two machines each doing the work equally well the purchaser is going to take the best-looking machine pretty nearly every time. If that machine for making pearl buttons "looked awful," as your correspondent says it did, a good-looking machine might sell where this one wouldn't, and its looks might make just the difference between success and failure. W. H. S.

Holding Punches and Dies.

Editor American Machinist:

In a recent number of the AMERICAN MACHINIST I read of how a common punch press was converted into a disk notching press, and also of how a punch and die were made and held in the machine. I have another way of holding them, which might interest some of the readers, and which I have not seen anywhere else.

I make the punches like Figs. 1 or 2, the same shape all the way up, and with no shank nor special holder for each punch. Instead of that, I have a holder of machinery steel that serves for all, within certain limits. I took a piece of 2½x3x3⅝-inch material and turned the round shank to fit the ram of the press, smoothed the outside in the shaper and drilled and reamed a ⅜-inch hole about ⅞ inch from one side and at an angle of ⅛ inch in 3 inches with the other side, as shown in Fig. 3, and parallel with the bottom face. I then drilled a clearance hole for a slotting tool at *B* and cut slot *C* parallel with the sides and the bottom face ⅝ inch deep and almost 5/16 inch wide, as that is the width of the widest punches that I hold in it. Next I cut slo. *D* the same depth and ⅜ inch wide. A ⅜-inch drill rod was cut off 3½ inches long and a tapering flat filed on it like the cotter-pin of a bicycle crank, and hardened and drawn to a dark blue. All I now have to do in fastening my punches is to set them into that slot in the holder, drive in the pin, strike a couple of blows on the punch, to make sure it rests in the bottom of the slot, and drive the pin home. For the thinner punches I put some sheet-iron shims between the pin and the punch. This holder fits for punches from 3-32 to

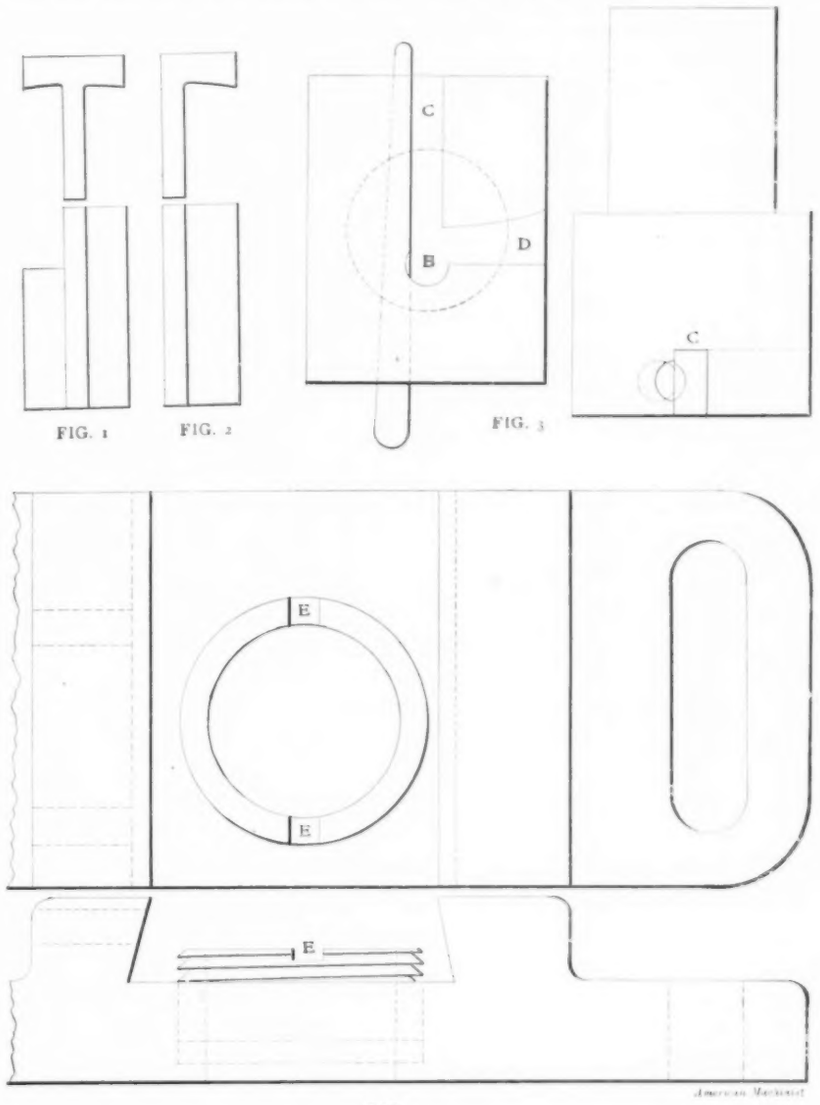


FIG. 1 FIG. 2 FIG. 3

FIG. 4

HOLDING PUNCHES AND DIES.

5-16 inch thick. It holds firmly and gives no trouble. Of course, the bottom of the slot, as well as the part of the punch which rests against it, must be straight, so also the side of the slot against which the punch is forced by the pin, and also that part of the punch, or the pin would press it straight and cause it to bend at the cutting end and crowd in the die. I only harden about ⅜ inch up from the end of the punch, putting a little cyanide of potassium on and leave it that way without tempering if I am going to use it on material less than .025 inch thick, but draw it a trifle for heavier plates. Punches of this kind have stood up for 105,000 notches in one grinding, but that is an exception, while from 30,000 to 60,000 is not uncommon, but that depends a great deal upon the care of the operator.

The die holder also is a little different from ordinary holders, in that I have a threaded hole in the center (see Fig. 4), and in this fits a threaded ring which makes the adjusting of the die vertically very easy. The die ought to lie at about a level with the center-plate of the machine where the blanks are placed. You will notice that the thread is cut at right angles on one face, so as to secure a good support for the rim. The cut *E* in the ring is for a wrench. This device I have used for a number of years, and it has given perfect satisfaction, doing away with piling up blocks and strips under the die to adjust it to proper hight.

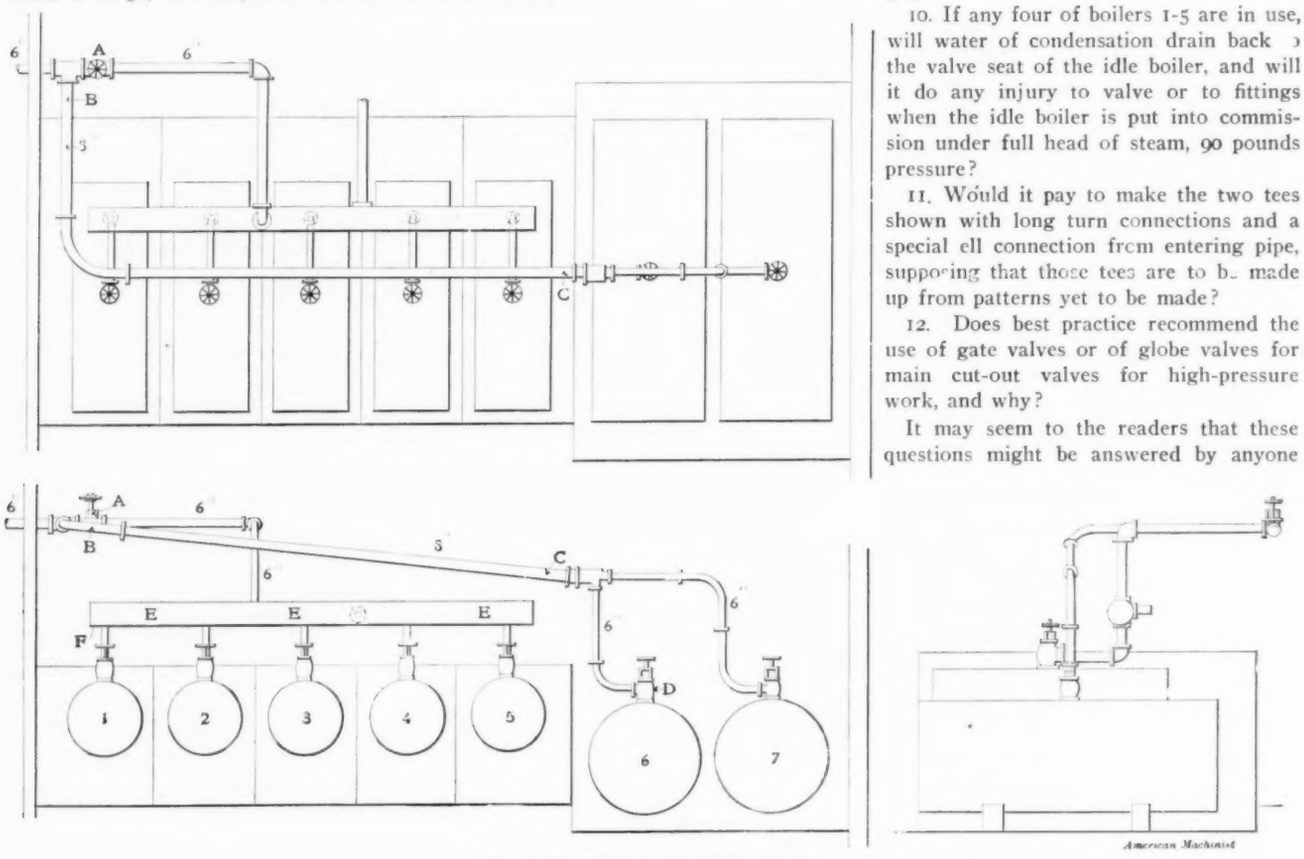
TOOLMAKER.

Some Boiler Pipe Questions.

Editor American Machinist:

I would like to submit the enclosed sketches to the AMERICAN MACHINIST and its readers for criticism. The opinions of the contracting experts were so different from my own that I submit sketches and draw attention to the various questions which arose.

The boilers, 1-5 inclusive, are to work under a pressure of 90 pounds and are supposed to furnish all the steam required under ordinary conditions. Boilers 6 and 7 are to work under 125 pounds pressure and are to be used as auxiliary boilers, but unless necessity demands are to be kept out of commission. The points in question are as follows:



AN ARRANGEMENT OF BOILER PIPING.

1. Is a reducing valve necessary for safety, supposing that the valve *A* is closed when boilers 6 and 7 are in use?

2. Will the water of condensation in main pipe *B C* have any ill-effect by draining back to seat of valve *D*, supposing boilers 6 and 7 to be out of commission?

3. Will water of condensation in pipe *B C* drain back to boiler 6 when this boiler is operating under 125 pounds pressure, or will it be forced along with the steam into main delivery pipe beyond *B*?

4. Will any harm result from running the two 6-inch supply pipes from boilers 6 and 7 into an 8-inch pipe, and later running the 8-inch pipe into a 6-inch at *B* when both 6 and 7 are in use?

5. Will the water of condensation from main steam drum *E* drain back into boilers 1-5 when they are running under 90 pounds pressure?

6. Is it better practice to run the connection from boilers 1-5 into the side of the drum rather than into the bottom, and to have a drip from drum, say at *F*; also is it better to take the 6-inch and 8-inch pipes from top of drum rather than one top and the other side?

7. Should main steam pipe *B C* be dripped at *B* or at *C*?

8. In the layout as shown, is it necessary to drip the copper bends from boilers 6 and 7?

9. If valve *A* was open, will the same pressure be shown on all seven boiler gages?

10. If any four of boilers 1-5 are in use, will water of condensation drain back to the valve seat of the idle boiler, and will it do any injury to valve or to fittings when the idle boiler is put into commission under full head of steam, 90 pounds pressure?

11. Would it pay to make the two tees shown with long turn connections and a special ell connection from entering pipe, supposing that those tees are to be made up from patterns yet to be made?

12. Does best practice recommend the use of gate valves or of globe valves for main cut-out valves for high-pressure work, and why?

It may seem to the readers that these questions might be answered by anyone versed in elements of steam engineering, but it certainly does not seem more so to them than to the writer, as the discussion took place among well-known engineers. I should be very glad to learn the opinions of any of the AMERICAN MACHINIST'S readers who are interested in steam engineering according to up to-date practice.

ENGINEER.

Our opinions upon the points raised by our correspondent are as follows:

1. We do not think a reducing valve advisable. So far as safety is concerned, the safety valves on the boilers 1-5 should take care of that. Moreover, a reducing valve is of slight use unless there is a draft of steam through it. With boilers 1-5 closed off, there would be no such draft, and a slight leak, if greater than the

condensation, would accumulate full pressure on those boilers, and such valves are apt to become leaky. If present, such a valve would be depended on as a safety feature and, but for the safety valves, it would be in reality a source of danger.

2. The pipe *B C* will certainly fill with water, and when one of the boilers 6, 7 is turned on with steam up, such water will be driven in a body into the engine.

3. All experience shows that the water will go with the steam regardless of the inclination of the pipe. Chas. E. Emery related a very striking case of this kind before the American Society of Mechanical Engineers a few years ago. The incident described by him occurred in connection with the uptown plant of the New York Steam Company and was conclusive.

4. The 8-inch pipe appears to be of unnecessary size, but we cannot see that any harm, beyond a trifling increase of condensation, will follow.

5. No.

6. We should connect the pipes to the side of the drum and then put in a drip at one end, this drip going well below the water line. As regards the location of the pipes leading from the drum, we see no choice.

7 and 8. As between *B* and *C*, at *C* by all means. A drip at *B* would accomplish nothing. If the pipe *B C* must run as shown, the copper bends should be dripped. If head room permits, the right-hand end of *B C* should be raised so that it may incline in the direction of the steam flow. We should then prefer that valve *D* and its mate on boiler 7 be raised to the level of pipe *B C* and have long rods to bring the hand wheels to convenient positions. Some might, however, prefer to keep the stop valves where they are and then drain the vertical pipes. The objection to this is that, as steam is always in the pipe *B C*, that location of the stop valves provides no way to shut off any part of the pipes between boilers 6 and 7 and the point *B* for purposes of packing joints.

9. Certainly.

10. The pipe will certainly fill full of water, which will play "hob" when the valve is opened. This would be prevented if the connections were made as advised in (6), the horizontal pipe from angle valve to drum being inclined toward the drum.

11. Yes.

12. Gate valves are best, especially for locations like *A*. Not only do globe valves obstruct the flow of steam, but they trap water in the pipe up to the level of the seat. If of large size, they are hard to open unless a by-pass is provided. As regards liability to leakage, there is not much choice. Angle valves as shown on the boilers are free from these objections, except as regards difficulty of opening. The trapping of water by a globe valve may, however, be largely overcome by turning it on its side so as to bring the stem to a horizontal position, although there is an objection to the horizontal position for large valves in such locations as this, as the stem projects over and obstructs the runway which is provided for giving access to the valves.

Painting the Smokestack.

Editor American Machinist:

At page 956 "Oil Stone" told of an experience in smokestack painting. I hope it is not too late to add a little more information on the subject.

The easiest way to have chimneys painted is to hire a professional "Steeple Jack" who will paint them for $5 apiece with a mixture of coal tar and turpentine, which he will tell you is a secret mixture of his own. The chimneys will look fine until the painter gets out of town.

The plant where I had charge had five chimneys of varying sizes, and every fall they were painted by one of the "profession" with the above-mentioned mixture, and at the uniform price of $25 for the job. The first annual painting after I took charge of the plant was attended by a serious mishap. The painter and his two assistants got drunk and one of them fell off a ladder through a skylight. The skylight was injured more than the man.

The following summer I decided to do the painting myself—that is, to have it done by the repair men at the mill—and here is what we did:

It never occurred to me to use a parachute, as "Oil Stone" did, to get a line over—in fact, it would have been impossible to have gotten inside the base of more than one of the stacks. I used a long pole to get the line up.

First I visited the blacksmith and had him make five hooks of ¾-inch round iron, like Fig. 1.

It will be noticed that the end of the hook is very deep—above 5 inches—to prevent any possibility of their jumping off the chimney. The eye was about 1¼ inches in diameter, to allow plenty of play for the passage of the rope.

Next, I told the millwright I wanted him to help me, and we made the pole which I have tried to illustrate in Fig. 2. This pole was constructed on what one might call a scientific principle, and was, perhaps, the most noteworthy part of the job. As the highest chimney was a trifle less than 60 feet high, the pole was very conveniently made of 16-foot strips. The upper section was a strip ⅞ by about 2 inches; the second section was a strip ⅞ by 2 inches, with a ⅞ by 1½ strip nailed to it to form an angle shape; section 3 was a ⅞ by 3 inch strip, with a ⅞ by 1½ inch strip nailed on to form a T; section 4 was in the form of a cross, made by nailing two ⅞ by 1½ inch strips to a ⅞ by 3 inch. The laps were about 2 feet, making a pole some 58 feet long. This pole was very light and stiff, and was successful in every way.

A pole as long as 100 feet could be constructed in the same way, which would be strong enough for the purpose and at the same time easily handled. If the sections were screwed together, the pole could be stored in a small space and used from year to year.

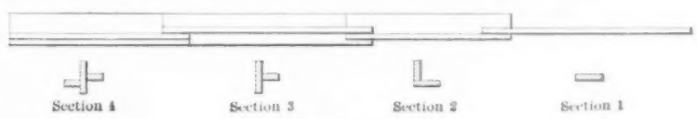


FIG. 2

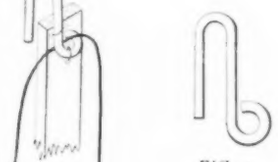


FIG. 1

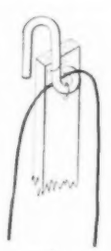


FIG. 3

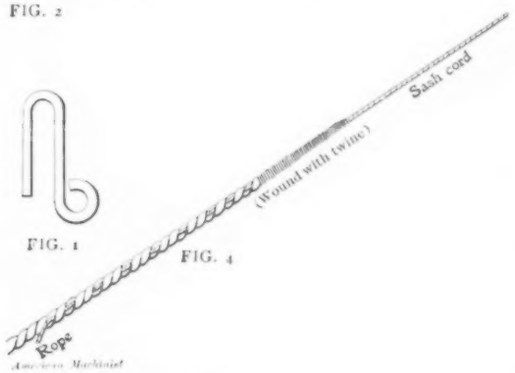


FIG. 4

PAINTING THE SMOKESTACK.

Four small holes were next bored in the top of the pole and the hook was lashed to it with twine in such a fashion that, while it would stay in place, the lashings were not so strong but that they could easily be broken. A hank of sash cord was procured and run through the eye of the hook, all as shown in Fig. 3.

One end of a long rope was unlaid and the strands cut out to make a good taper about 2 feet long and an end of the sash cord was spliced into the taper. This was in turn wound with twine to make a smooth connection between the rope and the sash cord. The taper was then well covered with soap to make it slide easily through the eye of the hook. Fig. 4 shows this.

It would seem that the next problem was to get the hook up over the top of the chimney, but this was very easy. We placed the top end of the pole on one of the guys and by a proper manipulation of the bottom end had it in an upright

position in no time. The hook was then hooked over the top of the chimney and one man took hold of the ends of the sash cord to prevent the reaction jumping the hook off, when the twine was broken. Another man pulled strongly down on the pole, breaking the lashing and leaving the hook at the top of the chimney.

A set of light blocks was lashed to the free end of the rope, and, by means of a long pull and a few gentle shakes, the rope was pulled through the hook taking the blocks to the top of the chimney. The end of the rope was fastened to a convenient post, a board seat was hooked on to the lower end of the fall, and we were ready to paint.

The painting was done with an old whitewash brush on a long handle, and, after Johnny, the Polander, caught the swing of the thing and learned how to crawl around the chimney, it was surprising how quickly he could cover the stack. The millwright's helper tended the rope and did the hauling up and down.

Fortunately, I have the figures on the job and the sizes of the chimneys, which were as follows: One 58′x36″, one 50′x 30″, two 35′x24″, one 45′x24″.

The cost of labor and paint was as follows:

8 hours, man, at 30 cents.....	$2.40
8 hours, helper, at 17 cents.....	1.36
20 hours, painter, at 14 cents.....	2.80
Total labor.....	6.56
10 gallons paint at $1.00.....	10.00
Total.....	$16.60

This shows a saving of $8.40. These figures do not take in my own time, but all my other work was attended to and, after the men were well started, no more time was given to them than would have been given to outsiders doing the same work.

I have used several kinds of paint on chimneys since then, but am convinced that the best quality of graphite paint goes ahead of anything else The stacks ought to be carefully cleaned of all loose, scaly paint and rust, by wire brushes before the paint is applied. R. P. KING.

Local Case Hardening—Hardening Slim Articles.

Editor American Machinist:

I have been much interested in the articles on local case hardening which have appeared in the AMERICAN MACHINIST recently, and have thought that perhaps to some of your readers my experience may be of interest. The piece shown in Fig. 1 is a bicycle axle which requires hardening at the ball races *A A* only, leaving the other parts soft. The way this is done in the majority of cycle shops over here is to pack up the part required to be soft with fire clay. I have no doubt it could be done by the nickeling method of local case hardening, as explained in the AMERICAN MACHINIST some time back, though I have never tried it. Some hardeners pack the central part only with fire clay, so that the ends from the ball races outward become dead hard. This is bad practice, for the crank is held to the axle by means of a cotter, and should a little back-lash be between them, which is almost certain to be the case sooner or later, the cotter, which is soft, is in time sheared through, owing to the constant jamming of the soft cotter against the dead hard axle. We are now hardening them in the following way: Pieces are cut off the required length from a black steel bar and the ball races are turned on, as shown in Fig. 2. They are then carbonized in the ordinary way, the scale preventing all but the turned ball races from being affected by the carbonizing; after this the turning is finished and they are then again heated but not again carbonized. When the proper heat is reached and they are ready for dipping into the water, they are gripped on the center part with tongs, as shown in Fig. 3, and dipped into the water. Gripping with the tongs in the way shown prevents them from going out of truth as

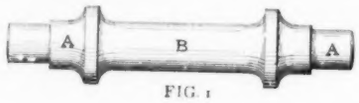


FIG. 1

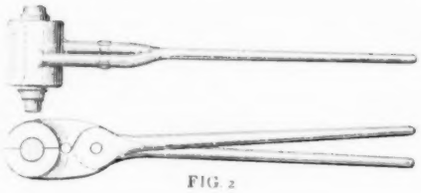


FIG. 2

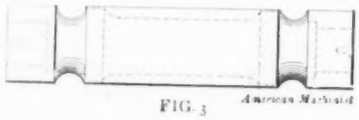


FIG. 3

ARRANGEMENTS FOR LOCAL CASE HARDENING.

much as would be the case if they were dipped without this, and at the same time it prevents the center part from becoming hard. We find the steel cannot be relied upon; some without this will keep soft, others become rather hard, with the result that the hard ones invariably snap in two when subjected to the pressure necessary for straightening. In case there should be any variation in the diameter of the work held, so as to let the water in between the tongs and the axle in any quantity, the hole in the tongs should be drilled larger and a sheet of asbestos inserted, which will allow for any slight variation in the diameter, though in my case this variation was so slight that the asbestos sheet was not required. If a little water does get in, which is pretty certain to be the case, the steam generated prevents any more from entering.

Seeing the article by Mr. Markham at page 761, on hardening long reamers, reminded me that my experience in this particular line might be of interest. Most small shops have no proper arrangement for hardening. The small amount of hardening does not seem to need any special arrangement, and if it did it would be doubtful if the boss would give it any consideration. I have found in my travels that the hardening branches of most concerns are very much neglected. An ordinary hearth, a bucket or two and a piece of sheet iron fixed over a gas jet, with sometimes a rough attempt at a home-made Bunsen burner, complete the hardening and tempering outfit. A firm will buy a lot of expensive up-to-date machines and then neglect the cutters, the making and hardening of which is the most important factor in the success of those machines.

I have hardened reamers as slim as 3-16 inch diameter by 5 inches long successfully in the following way: In the water bucket I place a piece of tube the diameter of which should vary according to the diameter of the work. I heat the work to a cherry red and then dip as nearly as possible straight in the center of the tube. My belief is that if the work was dipped into the bucket itself, there being such a quantity of water all around it, would cool it too quickly, thus causing it to warp. In the tube the circulation of the water is more even, and, if the diameter of the tube is right, when the work is dipped in the water will warm to suit it. For work up to ¼ inch diameter I should use a tube about 1½ inches diameter; above ¼ inch and up to ½ inch, about 3 inches diameter. When the water in the tube becomes warm, all that is necessary is to lift the tube and move it around, which mixes the warm water in the tube with the cold water outside. This method is for long, slim articles only. I do not know that my theory of the success of the method is correct, but I do know that in practice it answers all right.

Birmingham, Eng. CHERRY RED.

Changed Views Regarding the Metric System.

Editor American Machinist:

Some years since I was asked to sign a petition to Congress asking that the metric system of measurements be officially adopted as the legal American standard; in common with many others I complied, under the impression that the ease of reckoning with decimals and the convenience of a logically harmonious system would be sufficient to compensate for all troubles, fancied and real, incidental to the change. Since then actual experience with the metric system has led to a revision of views, so that to-day I am decidedly "on the fence."

The one great and undeniable advantage that the metric system has above all others is to be found in the logical relation of the various units of length, surface, space and mass and their systematic derivation from one common unit of length. There can be no question of the great superiority of the metric system over any of the others at present in use in this one regard; there is in fact no other set of measures

that can be appropriately called a system, least of all the English and American hodge-podge.

That the metric system is a really satisfactory solution of the problem is, to say the least, doubtful. The convenience of its units as to size is debatable; but it is very likely that no series of units can be generally satisfactory. The requirements of the various arts and sciences are far too varied for that. The best unit, or series of units, is one that does not involve large figures. Manifestly it is in this respect impossible to equalize the conflicting needs of the astronomer dealing with units of millions of kilometers with those of the shopman and engineer dealing in units that range from millimeters to kilometers, nor yet to at the same time satisfy the intense longing of the physicist for a unit more convenient than the millionth part of a millimeter.

That argument of the advocates of the metric system that its unit, the meter, is a natural one, a certain definite portion of the earth's diameter, may be at once dismissed; it has already been proven that the meter's relation to the earth's diameter is, or was, not reliably known.

There remains the other chief claim—convenience in reckoning, owing to the metric system's having been built upon the decimal plan. This is really a very alluring claim, but will not bear close scrutiny. The decimal system is only in part more convenient than a binary system, but not wholly so, or even more so. It is in fact more uncertain in arithmetical operations than the decidedly faulty English system. This statement, directly opposed to my preconceived notions of a few years ago, is advanced as a result of direct experience with the metric system, extending now over three years. Having been gradually led to this conclusion, I determined to put it to a practical test. A certain problem—not made up specially for the occasion, but cropping up in regular practice—was submitted to seven draftsmen and designers, some of them of more than average attainments and all of them thoroughly familiar with the metric system through having used it almost exclusively in their practice and schooling. The correct result was arrived at by only three of the seven men.

The problem was at first given to but one man, and only the obviously wrong result led to its being handed over to others. The difficulty lay in the correct location of the decimal point; with one exception all had the correct numerals, but the men were apparently lost in the maze of decimal figures. The location of the decimal point varied by as much as six places.

The same problem with equivalent values in English units was then handed out. The correct result was arrived at by six out of seven men in an average of two-thirds the time taken for its solution in the metric system, showing that the percentage of error was very much less and the time considerably less with the binary system, notwithstanding the relative unfamiliarity of the men with the units of the binary system.

From the draftsman's point of view, the binary system is also decidedly more convenient. In mechanical engineering practically the world over the most generally used scale is smaller than one-half. With the metric system the next one available to one-half is one-fifth; this is small and not convenient as compared with one-fourth; going further, the inconvenience becomes greater with one-tenth than with one-eighth, etc. Actual use will convince anyone of the truth of this, as it has me, who confesses to having been very skeptical as to there being a practically noticeable difference in convenience of quarter against fifth and eighth as against tenth scales. To sum up:

1. A general international system of units for length, area, space and mass logically built up on some one base unit is very desirable. Whether that base unit is the meter, or foot, or some other, is essentially immaterial—the requirements of the various arts and sciences are too varied to admit of a generally satisfactory base unit.

2. A decimal system is not as convenient as a binary system in mathematical drafting-room or shop work, at least so far as mechanical engineering is concerned.

3. The universal adoption of some one system is desirable; a binary one, logically built up, if possible; if not, then a decimal system logically built up. If the latter be conceded, then the metric system is as good as any, and practically better, having already been widely adopted.

HENRY HESS.

The Clean Blacksmith Shop.

Editor American Machinist:

Being a constant reader of your valuable paper, I would like to say a few words on the subject taken up at page 1339 by Mr. H. R. Looker, foreman blacksmith, Ann Arbor Railroad, "The Clean Blacksmith Shop—Does it Pay?" Now, I am a blacksmith and have had seventeen years' experience at one of the largest steel manufacturing plants in the United States and have worked in different shops, and I have yet to hear of any foreman taking the trouble to concern himself in any way about the condition of the blacksmith shop. The shop in which I served my apprenticeship was built of brick and was about 125 feet long by 100 feet wide. It was part of a large building which was divided into three rooms—a machine shop in one end, a boiler shop in the other end and the blacksmith shop in the middle room, connected only by large sliding doors. There were two windows in one end and four windows and a double door in each side, but all the windows were about 8 feet from the floor, and in all my stay there I never saw any of them opened, winter or summer. This shop contains seventeen blacksmith forges, two large steam hammers and one heating furnace, with a bolt header, and it is run both day and night. Often when working in the daytime I have had to light a torch to be able to read the figures on a rule or square, yet we were expected to turn out first-class work. A man working in this shop never sees the sky unless he goes outside. I am satisfied that Mr. Looker would have a great deal more to say on this subject should he spend a week or so in this shop, as he would never see any sunshine in there. Should you see fit to print this, I think that other blacksmiths will agree with me in saying that this is a fair sample of the shops in some parts of the country.

BLACKSMITH.

Habits—Right- and Left-Hand Screws.

Editor American Machinist:

Mr. Osborne's letter on habits and experiences with right- and left-hand screws brings up a point that needs thinking about twice.

Taking the case of a cross-slide of a lathe: If the screw stands still (that is, without end motion when turned) and the slide moves, then the screw should be left-hand, but if the screw moves with the slide, as is the case with the compound rest of Pond and Reed lathes, and often with other machinery, then the screw to act the same as the left-hand screw in the first case should be right hand.

And this might be held as a law, were it not for the fact that we get into trouble when we come to the tail spindle screw. If the screw is turned with a hand-wheel, then it should be a right-hand screw, although it does not move with the spindle. Why this should be so is that for drilling and setting up the spindle the hand naturally grasps the top of the wheel. But if the screw is turned with a crank-handle, then the most natural thing to do is to turn from you to drill, and that calls for a left-hand screw.

With the exception of the hand-wheel on the tail spindle screw, it seems, so far as my experience and observation have gone, the law is sound which holds that where the screw does not travel with the slide it should be left-hand, and right-hand where the two move together.

The shifter or shipper pole or handle is another point. I had not supposed there was any question but what all shifter poles on lathes moved toward the headstock to start the machine forward, until I was told by an old machinist, who learned his trade at Bement's, that all his own lathes operated the other way.

There certainly should be a universal way, and it would be interesting to know if there are many localities where moving the pole away from the headstock to start forward prevails.

JOHN E. SWEET.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,400 copies are printed. Total for 1902, so far, 775,400 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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The "Technolexicon."

We have several times, in the past, referred to the praiseworthy and important enterprise of the National Society of German Engineers in entering upon the preparation of a vocabulary of technical terms in which the definitions and equivalents are to be given in English, German and French.

As we have often pointed out, the translation of technical matter is the most difficult of all translations. English-German and German-English catalogs, which are a laughing stock, are the direct outgrowth of this difficulty, and, inasmuch as this vocabulary aims directly at supplying the deficiency which leads to catalogs which result in nothing but derision by their recipients, machine-building houses have a direct business interest in co-operating to make this dictionary the success which such co-operation will insure.

The difficulty of making correct technical translations was brought home to us, and may be made plain to our readers, by the experience of a native of South America who was educated as a mining engineer at Columbia University and one of whose early business tasks was the translation of a mining machinery catalog into Spanish. He was apparently well equipped. His native language was Spanish and he was intimately acquainted with the machinery to be described. Nevertheless he found the translation a matter of the greatest difficulty and, although the catalog was not a large one, its translation was the work of months. The difficulty arose from the fact that while the translator's native language was Spanish, his technical education was all in English, and he hence had no knowledge of equivalent technical terms.

It is to remedy these conditions that the National Society of German Engineers has undertaken to publish a technical dictionary under the title "Technolexicon," which is to be made as comprehensive and complete as possible through the co-operation of other technical and industrial societies and of individuals native and foreign. Being aware of the great difficulty of such a task, and in order not to make the work too voluminous, the Society of German Engineers decided to publish the dictionary in the three mostly used languages, English, French and German.

It was in March, 1901, that this work was inaugurated by the appearance of a publication in the paper of the Society of German Engineers, through which for the first time the intention to publish such a comprehensive work was made widely known, and shortly afterwards printed information was sent to technical societies and individuals in Germany and abroad, stating the manner and ways in which contributions to the "Technolexicon" could be furnished by everybody in touch with the industry and with technical and engineering work.

Dr. Hubert Jansen, whose name was already connected with other encyclopedic works, was elected editor in charge of this great undertaking, and at the forty-third general meeting of the Society of German Engineers, held a few months ago in Düsseldorf, Germany, in connection with the industrial exhibition, he reported the progress of the work.

An idea of the comprehensiveness of the work can be concluded from the statement of Dr. Jansen that, though words have already been gathered for one and a half years by societies and individuals in Germany, Belgium, France, England and the United States, the collection will probably not be completed before the end of the year 1904, when the compilation of the contributions will begin, which will occupy about two years more, so that the manuscript will be ready by about the end of the year 1906, when it will go to the press.

It should be especially understood that a knowledge of French and German is not necessary in order to do effective work in this matter. Full explanations of technical terms in English will enable the editors to supply the French and German equivalents, and such explanations will, we imagine, be found necessary in the dictionary in addition to the equivalents, and especially in cases in which there are no equivalents. The following is a typical illustration of definitions of this class which is taken from the writer's note book:

Burden. A term used in America to designate the factor which is added to the cost of material and direct labor (see *Direct Labor*) in order to obtain the gross or total cost of manufactured goods. The word is synonymous with the phrases *shop charges, shop expenses* or *establishment charges,* which, especially the first two, are sometimes heard. The word *on-cost* is used in some parts of Great Britain.

Anyone can supply definitions of this kind. Should the terms be very uncommon, it is desirable to give at the same time the source, where the term may be found or used.

The principal sources for the "Technolexicon" are of course these contributions, but of *great value* are also *catalogs,* price-lists and other printed matter of industrial firms, from which the technical terms may be gathered by the assistant editors and other collaborators of the editorial staff of the "Technolexicon" in Berlin. It is highly desirable, therefore, in order to further the work of this dictionary, that all the manufacturing firms publishing printed catalogs, price-lists, etc., should send a copy of their printed matters to the "Editor of the Technolexicon, *Dr. Hubert Jansen, Berlin, N. W.* (7), *Dorotheenstrasse* 49," since, as already explained, the publication is largely in the interest of such firms. The "Technolexicon," once completed, will undoubtedly prove a most valuable help in the

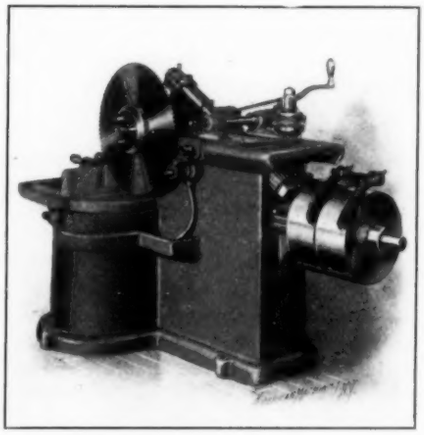
work of correctly translating catalogs from one language into another.

We cannot but admire the spirit of enterprise and of thoroughness with which the work has been undertaken, both of which, especially the latter, are thoroughly characteristic of the German people. As a business enterprise it cannot, of course, receive any adequate reward, and we doubt if such reward is expected. The least that engineers and manufacturers can do is to assist in so laudable and public-spirited an enterprise.

All who may be willing to contribute through collecting terms and phrases are urged to apply for note books, especially arranged for that purpose, and for letters of information directly to Dr. Jansen or to Dr. Alfred Mueller, 150 Nassau street, New York city.

Some New Things.

The illustration is of a cold-sawing machine of somewhat novel construction, which construction is made sufficiently clear by the illustration. Bevel gears transmit motion from the horizontal shaft



THE COCHRANE-BLY COLD SAW CUTTING-OFF MACHINE.

at the rear to the inclined worm shaft which drives the saw arbor, and the feed is by means of worm gearing driven by a chain and sprocket wheels from the saw arbor, a rack being attached to the side of the bed into which a pinion on the carriage gears. The vise can be swiveled to any suitable angle, and, as will be seen, the machine is of substantial proportions intended to do rapid and accurate work. An attachment is furnished by which saws are ground in place, thus saving the time of their removal and insuring that they will be ground true, so that every tooth will do its share of cutting. The machine is made by the Cochrane-Bly Machine Works, Rochester, N. Y.

Courses of Lectures to Journeymen.

Two interesting courses of lectures, which should also prove profitable to those for whom they are intended, are announced to be given at the New York Trade School, First avenue, Sixty-seventh and Sixty-eighth streets. One course is for journeymen electrical workers and the other for journeymen steam engineers, embracing in each case the entire field suggested by the purposes of the lectures. Each course is to consist of ten lectures, that for the engineers beginning on October 22d and then on alternate Wednesdays, concluding March 4. The electrical course will begin on October 31 and occupy alternate Fridays. The lectures will be conducted by Arthur A. Hamerschlag, and the charge for each course will be $1.

Outlook for American Machinery in Scandinavia.

[By our Special Correspondent.]

After having spent two weeks in Denmark, Sweden and Norway, I am glad to say that the outlook in the North is a little better than in Central Europe. I have called upon most of the principal dealers in machinery, and have seen a number of the leading engineering works. The latter are rather busy, and though the machinery merchants are not as well satisfied as they were a year or two ago, yet orders are coming in, and there is nothing of the general depression I found all over Germany.

Denmark is chiefly an agricultural country, and the principal demand is for agricultural machinery and implements. Highly developed in Denmark is the dairy industry, and cheese and butter making machines find always a ready sale. In this line, however, the Danes have established an industry of their own, and are not only selling their dairy machinery in the country itself, but also in many foreign markets. Besides agricultural implements, there exists at present a good demand for railroad material, rolling stock, steam pumps, conveying machinery, air compressors, gas and gasoline engines, petroleum motors, electrical machinery and small tools. The whole of Scandinavia does not produce any coal, and the fuel question is one of the most important problems of the North. In some parts of Scandinavia, American gas motors have been successfully introduced, but the great bulk of the requirements is still being supplied by Germany.

I cannot too often call the attention of our manufacturers to the fact that foreign trade can only be secured by hard and persistent work. Catalogs alone will never create business. I have been told by Danish machinery importers that the percentage of German and American commercial travelers is about 20 to 1.

Copenhagen, the capital of Denmark, with a population of nearly half a million, or almost one-fourth of the total population of the country, is a first-class distributing point for the entire Baltic trade. The volume of business has largely increased since the construction of an excellent free port, where goods can be stored at exceptionally low rates and transshipped to all ports of the Baltic. There are regular and direct steamers plying between New York and Copenhagen, and it needs only more energetic efforts on the part of our manufacturers to increase our trade with the Danish metropolis.

Norway offers especially a good field for sawmill and wood-working machinery. There is also an increasing demand for brick and clay working machinery. This industry is now represented by more than 100 works, giving employment to 3,500 hands. The machines used in this industry are chiefly of German make.

The Norwegian iron and steel industry employs some 10,000 hands, and is principally concentrated in Christiania. The most important engineering works are the Nylands Mekaniske Vaerkstad (1,000 hands), Akers Mekaniske Vaerkstad, Kvaerner Brug, and Myrens Vaerkstad, all of Christiania, and the Trondhjem Mekaniske Vaerkstad, of Trondhjem. Machine tools are chiefly of American and Swedish origin; general mill supplies come almost entirely from Germany and England. The textile industry has also made some progress, there being some seventy-five spinning and weaving mills in the country. The machinery is of English and German make. The wood-pulp industry gives employment to nearly 6,000 hands. The other principal industries are paper mills, tanneries, rope works, match factories, flour mills and tobacco factories.

The total importation of machinery and tools into Norway amounted last year in value to about $2,500,000. Unfortunately, the statistics of the industries of the country are far behind the times. The last official figures refer to the year 1895, at which time the motive power for all the industrial establishments of the country was furnished as follows: Water, 650 works; water and steam, 60 works; steam, 648 works; gas, 50 works; other power, 32. Since that time electricity has made great progress, and, as already mentioned, gas and petroleum motors have largely been imported.

Sweden is, in every respect, the most industrial country in Scandinavia. It has a highly developed mining industry, many large iron and steel works, a large number of up-to-date engineering works, shipbuilding yards, a great lumber industry, wood-working establishments of the first order, an important wood-pulp and paper industry, spinning and weaving mills, and minor industries.

The first place in the Swedish manufactures is occupied by the iron and steel industry. The value of the total output of the blast furnaces, rolling mills, foundries and engineering works amounted last year to nearly $65,000,000. The mechanical workshops produced goods to the value of $16,000,000. There are many large engineering works in the country. I mention only:

	No. of men employed.
Aktiebolaget Separator, Stockholm.	772
Nya Aktiebolaget Atlas in Stockholm.	776
Statens Järnvägars Reparationsverkstad in Stockholm, several workshops, State property, together..	1,800
Munktells Mekaniska Verkstads Aktiebolaget in Eskilstuna.....	738
Husqvarna Vapenfabriks Aktiebolaget in Husqvarna.....	1,052
Motala Verkstads Nya Aktiebolaget in Motala.....	1,253
Kockums Mekaniska Verkstads Aktiebolaget in Malmö.....	1,004
Göteborgs Mekaniska Verkstads Aktiebolaget in Göteborg.....	838
Aktiebolaget Bofors Gullspang in Bofors.....	728
Strömsnäs Järnverks Aktiebolaget in Degerfors.....	800
Fagersta Bruks Aktiebolaget in Fagersta.....	622
Avesta Järnverks Aktiebolaget in Avesta.....	748
Stora Kopparbergs Bergslags Aktiebolaget in Domnarfvet.....	2,199
Ljusne-Woxna Aktiebolaget in Ljusne.....	400
Sandvikens Järnverks Aktiebolaget in Sandviken.....	1,840

That such an important industry requires every year a good amount of machine tools is a matter of course. Our tools are highly appreciated in Sweden, and wherever I went I was told that our machines are the best in the world. In connection herewith I wish to call the attention of our manufacturers to the following: As a rule, patents are always taken out for England, Germany, France and Belgium. For Sweden, however, patents are never secured. The Swedes are very good mechanics, and our machines are to-day just as well imitated in Sweden as they are in Germany and Great Britain. I can state on good authority that a certain firm in Stockholm makes a specialty of imitating American machinery; they buy one machine, imitate it, and sell it at a much lower price than the American machine can be sold at. Almost every importer of American machinery complained about this point, and our manufacturers should by all means first secure a Swedish patent, and then sell their machines over here.

A far larger business could be done in machine tools if we would supply them with direct electric coupling by means of rotary current motors. Sweden is extremely rich in water power, and electricity is making steady progress. The manager of Schuchardt & Schütte's Filial, Stockholm, told me that he had written several times to the States regarding this question, but always received unsatisfactory replies.

The State Railroads are just now building new, extensive machine shops at Orebro, where the system above referred to will be installed. As the railroad could not get the machines with direct electric coupling (without belting) from the machinery importers, the order was placed with the Köpings Mekaniska Verkstad, where the machines are now being built after the company's own drawings and specifications.

The lumber industry takes the second place. The output amounts to an annual value of about $40,000,000. There are sawmills with several million crowns of capital, employing 800 hands and more. Quite a number of mills have as many as thirty saw frames. The machinery is largely made in the country itself, but also freely imported, the principal imports coming from Germany. I have no doubt that by strong efforts our manufacturers will be able to compete successfully in saw frames, band and circular saws, and general wood-working machinery.

Other machines finding a good sale in Sweden are those used in the mining industries. Many new fields have recently been discovered, and the prospects for a steady development of this industry are very good.

Great progress has been made of late by the clay-working industry, and machinery for this branch should also find a good field in Sweden. There is further on a demand for stone and marble working machinery, tools and machines for glass works, machines for the match industry, which is very important; wood-pulp and paper-mill machinery, and railroad material.

Strange to say, but American locomotives are condemned wherever I raise the question about our engines. The Swedish State railroads were not satisfied at all with the locomotives they received from the United States. The engineers complained especially about the way the different parts of the locomotives were packed. They were not marked, and in many instances whole parts had to be worked over again, while others had to be supplanted by new ones.

You will no doubt remember that a few years ago the Danish State Railways placed an order for a certain number of locomotives—I think eighteen—with the firm of Ernesto Breda & Co., of Milan, Italy. While in Copenhagen I asked about these engines, and was told that they gave "very satisfactory results." Should we not be able to supply just as good locomotives for foreign markets as our Italian friends? HENRY L. GEISSEL.

Stockholm, Sweden, September, 1902.

The John Fritz Medal and Banquet.

For some time past a committee of engineers has been at work raising a fund for the establishment of a gold medal, to be known as the John Fritz Medal, and which is to be awarded annually for meritorious engineering work. This movement has been set on foot in order to do honor in a striking, appropriate and permanent way to the personality and achievements of Mr. Fritz.

The efforts have been crowned with the success which they deserve, and that event, together with the completion of his eightieth year by Mr. Fritz, will be celebrated by a dinner in his honor at the Waldorf-Astoria on Friday, October 31.

The man and the double occasion will make this one of the notable events of American engineering history. We predict the same success for it that has attended the raising of the fund for establishing the medal. Full particulars may be obtained of John C. Kafer, Treasurer of the Committee, 374 Fifth Avenue, New York.

The United States Civil Service Commission announces that on December 9-10 an examination will be held for the position of mechanical draftsman for the Bureau of Engraving and Printing at Washington. The salary of this position is $1,000 per year, and persons who desire to compete should apply for particulars to the United States Civil Service Commission, Washington, D. C.

A reader wishes to know how to produce what is known as gun metal finish on steel.

The American Association for the Advancement of Science has changed its time of meeting, and its next gathering will occur on December 29 to January 3 at Washington, D. C.

The semi-annual report of Willans & Robinson, Limited, Rugby, England, shows a net profit of £33,449 ($167,000) and dividends were declared at the rate of 6 per cent. per annum on the preferred stock and 10 per cent. per annum on the ordinary shares.

Personal.

Christopher Metzler, a foreman who has been in the employ of B. F. Goodrich & Co., Akron, Ohio, for twenty-five years, has been retired by the firm upon full pay for the rest of his life.

Obituary.

Albert H. Saunders, an inventor and formerly a machine shop proprietor, died at Nashua, September 11, seventy-one years old. Mr. Saunders, who was a native of Rhode Island, began his business life as a civil engineer, but at the age of twenty-six he became superintendent of a textile mill and gave his attention to mechanical affairs and invented several devices which proved remunerative. He started a machine shop of his own in 1866 and for a time it was the largest experimental shop in New England. He gave up the business in 1888, and for a time was occupied in civil engineering and as an architect.

Commercial Review.

NEW YORK, October 13, 1902.

For some time past efforts have been made to form a combination of all steam pump manufacturers not identified with the International Steam Pump Company. On several occasions current reports indicated that the project was on the verge of consummation, but as yet nothing definite has been accomplished in the matter.

We understand on excellent authority, however, that a meeting of those interested in the proposed merger was recently held in Buffalo, and that the subject was taken up only in an indirect way, in consequence of the belief that a matter of greater moment was the question of an increase in prices, because of the constantly increasing cost of labor and material. We are also informed that when this was discussed, a representative of the International Steam Pump Company was admitted, and took an active part in the proceedings.

It is a fact not generally known to the trade that while the International Steam Pump Company was organized in 1900, the prices charged by the companies who entered it at the time are the same to-day as a general rule, that these companies were charging then. Yet everybody knows that during the past two years, and notably during the past year, the tendency toward higher prices for labor and material has been most marked.

Despite these facts, our advices are that no agreement in the nature of a concerted increase in prices was reached, although the propriety of such a course was conceded on all sides. There was a difference of opinion, however, as to the general details of the increase, and we understand that the probabilities of an amicable adjustment of them in the near future are of the best. The initiative in the matter will be taken by the International Steam Pump Company, which is thought to control about 75 per cent. of the steam pumping machinery output of the country.

American manufacturers of electrical machinery were greatly surprised recently, when the cables announced that the contract for constructing a complete electric lighting plant and tramway at Manchester, England, had been awarded to the Allgemeine Electrical Company, of Germany.

This is one of the largest contracts for electrical machinery that has been given out in England in years. It amounts to about $700,000, and several American firms were numbered among the bidders. English firms were well represented among the bidders also.

The fact that the German company was enabled to out-bid both its English and American competitors affords another demonstration of the belief, that until the German manufacturers get rid of the large amount of machinery left on their hands by reason of the recent industrial crisis in Germany, both English and American manufacturers cannot compete with them, all other things being equal.

Until this contract was awarded, however, an impression prevailed that any machinery of German make could not get a foot-hold in England under any circumstances, because of the antipathy the average Englishman was thought to bear against the Germans, and for reasons which are well known. Even the German manufacturers themselves gave credence to this, by seeking an outlet for their surplus stock in almost every quarter of the globe, except England. The fact, however, that the Allgemeine Company has triumphed shows either that England and Germany are willing to forget the past, or that Washington Irving was right when he said that Johnny Bull never stands on ceremony where a dollar is to be made or saved.

No report issued by the United States Steel Corporation since its organization has received greater consideration in the editorial columns of the daily newspapers than that which has been bestowed on the quarterly statement recently issued. The comments passed upon it have been of the most flattering kind, especially those which New York city newspapers have indulged in. The latter regard the good showing made by the corporation as especially significant in view of the depression which has made itself felt in financial circles recently, for which the high rate of money has been largely responsible.

From the criticisms which have been made on the report, the inference can be drawn that there was a time when it was thought that when there was any upheaval in Wall Street, particularly when the money market was unsettled, the path of the average industrial concern was perforce strewn with thorns. The daily newspapers seem to think that whatever reason there may have been for such an apprehension in the past, it either does not obtain at all now, or, if it does, it is but lightly, and point to the recent report of the United States Steel Corporation as proof positive of their contention.

Another deduction that can be drawn from the criticisms is that as long as the United States Steel Corporation continues on the high road of prosperity, industrial enterprises embraced in the iron and steel industry can be understood to be operating along successful lines also. In other words, the corporation is looked upon as sort of a barometer of iron and steel interests by those outside of the latter; whether or not this is so, the fact remains that the policy of the corporation since its inception is regarded as being a model one for industrial establishments to adopt, and examples are numerous where old as well as new industrial interests have made their management conform to it.

As this column goes to press, a large number of machine-tool men are gathering at the Hollenden Hotel, Cleveland, Ohio, to attend the inaugural convention of the National Machine Tool Builders' Association, which convenes on October 14 and 15. Representatives of the following firms will be in attendance at the convention:

Hoefer Manufacturing Company, Freeport, Ill.; Ohio Machine Tool Company, Kent, Ohio; Springfield Machine Tool Company, Springfield, Ohio; Sibley & Ware, South Bend, Ind.; Flather Planer Company, Nashua, N. H.; the Wilson Machine Company, and the W. P. Davis Machine Company, of Rochester, N. Y.; H. G. Barr, the Blaisdell Company, Prentice Brothers Company, J. E. Snyder, Woodward & Powell Company and the Whitcomb Manufacturing Company, of Worcester, Mass.; the B. F. Barnes Company, Rockford, Ill.; Gould & Eberhardt, Newark, N. J.; Aurora Tool Works, Aurora, Ill.; the American Tool Works Company, Cincinnati Planer Company, Cincinnati Machine Tool Company and the Cincinnati Shaper Company, of Cincinnati.

The subjects chosen for discussion cover all of the important branches of the machine tool industry, and suggestions will undoubtedly be made and policies adopted which cannot but have a salutary effect on trade.

During the past week considerable surprise, as well as regret, was expressed in the trade over the announcement that the Grant Tool Company, of Franklin, Pa., had gone into the hands of a receiver. We understand that a variety of circumstances, among them the failure to make deliveries with promptness, due to causes over which the company had no control, has been responsible for the predicament in which the company now finds itself. The liabilities are placed at $230,000, and, while the assets are not named, advices are that they are at least as large, if not larger.

The Grant Tool Company was organized a few years ago, and is the successor to the Grant Machine Tool Works, and the Grant Ball Company, of Cleveland, Ohio. The company manufactured lathes, drill and boring mills, pulleys, etc., and its plant at Franklin has a floor space of 100,000 square feet.

We understand that the business will go on as usual, and that a reorganization of the company is now in process of formation. The company was represented in New York by the E. W. Irwin Machinery and Supply Company, at No. 114 Liberty street.

Charles H. Besly & Co., of Chicago, Ill., report their general business as very good, the month of September being one of the largest in the amount of sales that they have ever enjoyed. They are making many shipments of their Gardner grinders to various parts of the country. At this season of the year they are closing many contracts with agricultural people for their Helmet oil, Badger and Bonanza cups, the same having been adopted by

the International Harvester Company, McCormick, Plano and Deering divisions, Avery Manufacturing Company, Port Huron Engine & Thresher Company, Sandwich Manufacturing Company, Safety Shredder Company, Newark Machine Company, Parsons Band Cutter & Self Feeder Company and other makers of agricultural machinery. They are receiving numerous orders for complete shop equipments and for tools and supplies for repairs and replenishing. Their new 300-page general catalog will be mailed free on application.

The Illinois Car & Equipment Company, of Hegewisch, Ill., just outside of Chicago, has recently purchased a large amount of electrical apparatus which will be used for the operation of wood-turning machinery. An order on the Westinghouse Electric & Manufacturing Company includes two 250-kilowatt and one 200-kilowatt two-phase alternators, together with a four-panel switchboard and the following induction motors: two 100 horse-power, five 75 horse-power and one 50 horse-power.

The Chicago Pneumatic Tool Company reports that owing to the increased business it is receiving from the Southwest territory it has deemed it advisable to again place a representative in that district, and therefore has located its Mr. W. C. Walker in St. Louis, with headquarters at 325 Lincoln Trust Building. The company believes this arrangement will greatly facilitate handling the volume of business received from that territory and will be very advantageous to both the company and its customers.

The Steel Storage & Elevator Construction Company has adopted electric power distribution for a large grain elevator which will be erected for the Canadian Pacific Railway at Fort William, Ontario. A recent purchase from the Westinghouse Electric & Manufacturing Company includes a direct current generator and a number of direct current motors for the operation of this elevator.

The recent encampment of the Grand Army of the Republic at Washington, and the low rates of fare which the railroads made from all over the country for those who desired to attend it, brought a great many machine-tool builders to this city. One large machine-tool concern had five visitors from Cincinnati alone, and other houses were surprised as well as pleased to receive a call from customers living some distance from New York.

The Browning Engineering Company, of Cleveland, Ohio, has recently purchased from the Westinghouse Electric & Manufacturing Company a large number of railway-type crane motors, ranging in capacity from 25 to 50 horse-power.

The list of machine tools desired by the Baltimore & Ohio Railroad for the new repair shops it is building at New Castle Junction, Pa., has reached the "street." It means an expenditure of about $60,000.

Cable despatches announce that the commissioners appointed in England to investigate trade conditions in South Africa have made their report. The latter states that in the matter of engineering, mining, electrical and agricultural machinery American manufacturers have made the most headway, with their German competitors a close second. The commissioners say English manufacturers have not made their presence felt at all in the country, and declare they can blame their antiquated business methods for it.

The report speaks in glowing terms of the possibilities of trade in the country, and uses no ambiguous language in predicting that unless manufacturers on the Continent bestir themselves, Americans will walk off with the lion's share of it. At the present time American mining machinery is almost universally used in South Africa.

Regarding trade conditions in South Africa, United States Consul-General H. Clay Evans, London, sends to the State Department newspaper clippings, which read in part as follows:

"The only serious competition will come from America. One reason why the costly mine machinery has in late years come largely from the United States is this: The kind of machine used on the Rand is to all intents the same as has been used in the silver mines of Nevada for many years, and competition there evolved the fittest, so that when these fields began to develop there was the plant ready for shipment in New York, but in spite of low ocean freights the American has been gradually pushed back, until we find—what? That Fraser & Chalmers, the one-time monopolists of mine outfits, have started huge works at Erith for the production of this heavy machinery. There is not a British drill at work on the Rand; they are heavy, cumbrous, slow. The American machine is light, compact, easily worked. The Fraser & Chalmers plant at Erith is operated by an English company, organized some years ago to manufacture the specialties of Fraser & Chalmers, of Chicago, now part of the Allis-Chalmers Company, Broad-Exchange Building. Considerable machinery, however, is being held in the Chicago shops for the South African markets. The Gates Iron Works, also part of the Allis-Chalmers Company, are also filling orders for the same field. As to drills, they are made principally by the Rand Drill Company, of 128 Broadway, and the Ingersoll-Sergeant Drill Company, whose offices are in the Havemeyer Building. Both those concerns have large orders on hand at present."

CHICAGO MACHINERY MARKET.

The general impression about electrical machinery during the past month is that trade has been inclined to be quiet. Factories are generally reported to be busy, some of them so busy that they are not looking for additional business. A Chicago electrical machinery man, wishing to make other business connections, wrote to an Eastern manufacturer of machinery, not represented directly at Chicago, asking for the agency. The reply was that the manufacturer would be glad to take up the matter later, but that just now they were working twenty-four hours a day and that even with that activity they were unable to keep up with their orders. It is in the sales departments that one hears of the dropping off of trade. The subsidence is not especially significant, for at this time the volume usually wanes, quiet prevailing until about the turn of the year. There are, however, a considerable number of projects which have been under negotiation for some time and which it was thought would be closed ere this, but still they drag, and when inquiries are made concerning the same the reply comes that the prospective buyers are not ready to take up the matter just now. In some instances there are special reasons. Thus the Omaha Packing Company has been an inquirer, but is procrastinating. The inference is that the supposed negotiations looking to a combination of the large packing interests may be delaying the placing of the order. In other instances shops to be equipped electrically are so busy that the owners are reluctant to make the interruptions necessary for the change in power.

A fair amount of business is current, but it is running more largely than usual to smaller installations. The American Varnish Company, Chicago, has contracted to make an electrical installation, the generator being 30 kilowatts. The Brunswick-Balke-Collender Company is equipping its Chicago plant electrically. When completed they will have about 1,000 horse-power in motors with corresponding generators. The United States Printing Company, part of the United States Plain Card Company, has bought about sixty motors. The Adams & Westlake Company has purchased from the Sprague Electric Company and from the Crocker-Wheeler Company additional motors, and will eventually equip the whole shop electrically.

Among recent motor sales of the Crocker-Wheeler Company are the following: Allis-Chalmers Company, Milwaukee, 50 horse-power; Algoma Steel Company, Sault Ste. Marie, Ont., 100 horse-power; Patton Paint Company, Newark, N. J., 200 horse-power; Armour Fertilizer Works, Atlanta, Ga., 100 horse-power; Minnesota Steel and Machinery Company, 112 horse-power; Simple Account File Company, Fremont, Ohio, 57 horse-power; Findlay Table Manufacturing Company, Findlay, Ohio, 122 horse-power, also two generators aggregating 96 kilowatts; Armour & Co., 400 horse-power for East St. Louis and 200 horse-power for Fort Worth, Tex.; Reedy Elevator Company, 140 horse-power.

Quotations.

NEW YORK, Monday, October 13.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:

No. 1 X	$23 50	@	$25 00
No. 2 X	22 75	@	23 50
No. 2 plain	22 25	@	22 50

Southern:

No. 1 Foundry	22 00	@	23 00
No. 2 Foundry	21 75	@	22 50
No. 3 Foundry	21 25	@	22 75
No. 4 Foundry	20 25	@	21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11½ @ 11⅝c.; electrolytic and casting, 11.35 @ 11.50c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 25⅜ @ 25½c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5⅝c.

Antimony—Cookson's, 9½c.; Hallett's and U. S., 7¼ @ 7¾c.

Lard Oil—Prime City, 78 @ 82c., according to brand and quantity ranging from one barrel up to large lots.

Manufacturers.

The Big Four Railroad has decided to erect repair shops in Anderson, Ind.

A new mill is to be constructed for the Hudson (Mass.) Worsted Company.

The Keever Starch Company, Columbus, O., has purchased land for a new plant.

The sawmill of the Huron Lumber Company, Alpena, Mich., has been burned.

The Iowa Pipe & Tile Company, Des Moines, Ia., has begun the erection of a new plant.

The Hall Signal Company has contracted for an addition to its factory at Garwood, N. J.

The American Tube Works, Boston and Somerville, Mass., will build a new plant at Somerville.

A two-story addition, 40x80 feet, will be erected by the Lufkin Rule Company, Saginaw, Mich.

The Ball Engine Company, Erie, Pa., has received some structural steel for use in building its new plant.

The Dentler Bagger Company, of Vicksburg, Mich., is building an addition to its plant for a machine shop.

It is said that a new factory is to be erected at Owosso, Mich., by the Vigor-o Health Food Company, Limited.

Griffin Wheel Company, Chicago, Ill., manufacturer of car and engine wheels, will build an addition to its Detroit plant.

A four-story building is about being put up for M. Gould & Sons Company, manufacturers of trunk hardware, Newark, N. J.

The plant of the Hubbard Fertilizer Company, of Baltimore City, Md., which was destroyed by fire recently, will be rebuilt.

W. C. Ritchie & Co., manufacturers of paper boxes, Chicago, will erect at South Chicago a three-story factory to cost $20,000.

F. C. Johnson and George Manning, of Anderson, Ind., are building a heading factory, costing about $50,000, at Mattoon, Ill.

Plans will be made for a plant of the Hanly Packing Company, Chicago. The cost of the first buildings will be about $100,000.

The contract has been let for an addition to the machine shops of the American District Steam Company's plant, Lockport, N. Y.

A factory addition building permit has been taken out by the James Ohlen & Son Saw Manufacturing Company, Columbus, O.

The Cleveland (Tenn.) Woolen Mills will be moved to Chattanooga, where a plant and equipment costing $100,000 will be established.

Harvey Abrams, contractor, Knoxville, Tenn., will build shops at Winston-Salem, N. C., and put in the latest improved machinery.

James W. Woods, of Queen street, Ottawa, Ont., lumbermen's supplies, etc., is having plans prepared for the erection of a large factory.

A new engineering building is contemplated by the Williamson Brothers Company, machinist and boiler manufacturer, Philadelphia, Pa.

A permit has been taken out to build a factory addition for the Southwark Mills Company, cotton and woolen goods, Philadelphia, Pa.

Plans are being prepared for a four-story, 30x102-foot addition to the machine shop of the Victor Talking Machine Company, Camden, N. J.

The Reed Manufacturing Company, manufacturer of anti-rust tin ware, Newark, N. Y., is about to begin the erection of a new and larger factory.

The contract has been let to build an addition to the plant of the Niles-Bement-Pond Company, at Meadow and Mifflin streets, Philadelphia, Pa.

A new foundry is being erected at Olympia, Wash., by the Olympia Iron Works Company, in connection with the machine shops already in operation.

Plans and specifications for a new power-house for the United Gas & Electric Company, Dover, N. H., have been submitted to contractors for bids.

Plans are being made for alterations, changes and additional buildings for the Pullman Company, of Pullman, Ill., manufacturer of palace cars, etc.

It is unofficially announced that the Elwood (Ind.) plant of the American Tin Plate Company is to be made the largest and most modern tin plate plant in the world.

It is stated that Benjamin Strickler, manufacturer of mill machinery at Ben Roy, Pa., is seeking to secure a site in Red Lion for the erection of a manufacturing plant.

The directors of the Merrimack (textile) Manufacturing Company, Lowell, Mass., will ask the stockholders to increase the capital stock for building a new mill at Huntsville, Ala.

The Madison Brick Company's plant at Summitville, Ind., has been purchased by C. F. Heritage, of Anderson, and Dr. A. E. Harlan, of Alexandria. The plant will be enlarged.

The Standard Motive Power Company, which will locate its locomotive works at Canal Dover, O., has let the contract for the boiler shops, 500x200 feet. There will be fifteen other buildings.

It is said that the International Pulp & Paper Company will erect a paper mill at Morrisonville, N. Y., next spring, that will manufacture into paper their wood pulp product of the Saranac River.

It is announced from Warren, O., that the Diamond Brick & Tile Company (capitalization, $10,000) has been organized by Thomas and William Brown and N. H. Merwin, of Diamond; F. H. Mattes and C. H. Herner, of Newton Falls, who will erect a plant at Diamond, Portage County, for the manufacture of brick, tile and building block.

The Sharon (Pa.) Steel Company is building another blast furnace, to cost $750,000 and have a daily capacity of 400 tons. The contracts for three pairs of blowing engines were awarded to McIntosh, Hemphill & Co., of Pittsburg. The contract for the ore-handling machinery went to the Brown Hoisting Machinery Company, of Cleveland.

Land in the town of Elberta, Wood County, Texas, has been sold to a syndicate, representing St. Louis and Texas capital. The St. Louis members are M. M. York, Tom L. Cannon and F. M. Estes, counsel for the Colonial Trust Company and the Missouri Trust Company. The new owners mean to build canning and other factories and mills.

The Pawcatuck woolen mills, of Woonsocket, R. I., have been incorporated by William J. Battey, Frank T. Trull and Thomas L. Foulkes, of New York; Charles L. Staples, of Pittsfield, Mass., and John B. Dunn and S. Dunn, of Woonsocket. The capital stock is $100,000. The company is formed to operate a woolen mill in Westerly, R. I. In the plant 100 looms will be placed.

Articles of incorporation for the Daniels Linseed Company, of which J. W. Daniels, a Cleveland (Ohio) linseed oil manufacturer, is at the head, have been filed, and a mill will be erected in St. Paul, Minn. The new company is capitalized at $250,000. Part of the machinery at the mill in Ohio will be moved, but the most of the machinery to be installed in the St. Paul mill will be new.

The F. F. Pulver Manufacturing Company (capital, $200,000), promoted by Hon. Chas. B. Ernst, has been formed at Rochester, N. Y., to manufacture advertising novelties. It will employ a process for applying impressions to the surface of celluloid and fiberoid. There are manufacturing facilities at present, but the company proposes to establish a larger plant. It will have lithographing and printing departments.

H. B. Rackhill will open a general machine shop in Roanoke, Va., December 1, having purchased a two-story brick building, 50x100 feet, for that purpose. The capital is $10,000. The concern will be known as the Rackhill Machine Works. Mr. Rackhill has been employed by the United Cigarette Machine Company, Ltd., Lynchburg, Va., for the past two years, as superintendent of its shop, which position he will resign on October 28.

A large new factory is to be built in the Suburban town of Lake by the Filer & Stowell Company, Ltd., manufacturer of steam engines, etc., Milwaukee, Wis. The company has obtained thirty-seven acres two blocks from the Nordberg Manufacturing Company plant. The erecting shops and machine shops on the present site will not be removed at first, and the work now being done is for the building of a foundry.

There is a project to establish near Buffalo, N. Y., a large copper smelting works. A syndicate owning copper interests in Alaska is financing the deal. James Shirley, the representative of the syndicate, has been stopping at the Hotel Iroquois. Oliver S. Garretson is said to be taking a lively interest in the pro-

posed works. Mr. Shirley has approached Jacob Dold, relative to the purchase of land. The proposed site comprises 500 acres.

The Hightstown (N. J.) Electric Light & Power Company will supply power, heat and light for the new plant being built by the Hightstown Smyrna Rug Company. This will necessitate the extension of the hours of electric service, and several manufacturers will substitute electric for steam power in consequence.

Edgar T. Ward & Son, Boston, Mass., on account of increased business, have been compelled to erect a new brick warehouse, 100x80 feet, on Pittsburgh street, in South Boston, to be used for the storage of shafting, tool steel and cold rolled steel and for wholesale shipments. This, with their Purchase street store, doubles their capacity.

The Buffalo (N. Y.) Belting Company is installing at the works of the Buffalo Weaving Company machinery which is said to be a test plant, looking to the construction hereafter of a large manufactory. The process is a new one. The Buffalo Belting Company's belt will be a woven cotton one with a patent rubber composition cover, that it is claimed will make the belt waterproof and as good as leather in regard to adhesive and wearing qualities.

Contracts for improvements to be made by the Otis Elevator Company, of New York city, on a site at West Sixteenth and Laflin streets, Chicago, have been let to a Cleveland construction firm. The first structure to be erected is a foundry, which will cost $75,000, but a warehouse and a machine shop are soon to follow. The company, it is said, will expend in all about $250,000 in the enlargement of its plant. This may mean exclusive of equipment.

A certificate of incorporation has been filed at Dover, Del., for the Columbiana Clay Manufacturing Company (of which, when organized, the main office will be at Pittsburg) to mine, mill and deal in clay and other minerals for the manufacture of tiling, brick, etc. The incorporators are: H. J. Lawrence, Pittsburg; Daniel C. McCurdy, Sheraden, Pa.; Louis T. Pfarr, Rogers, O. The capital stock is given as $300,000. The company will build a plant at Rogers, Columbiana County, O.

Mordecai T. Endicott, Chief of the Bureau of Yards and Docks, Navy Department, Washington, has invited estimates for two additional buildings at the League Island Navy Yard, a coppersmith shop for the steam engineering department and a house for the locomotive crane machinery. Bids on the former are due October 18, 1 P. M., and on the latter, October 11, 1 P. M. Philadelphia builders are also figuring on a steam engineering building, for which there is an appropriation of $214,000.

The A. Garrison Foundry Company, Pittsburgh, Pa., has completed its plan for improvements. An extension, 67 feet long, will be built to the machine shop, with a 25-ton electric crane. A power-house will be erected with three 125 horse-power gas engines and three generators, as the entire plant is to be lighted and operated by electricity. A new foundry building will be erected, and a three-story building, 48x120 feet, will be built for a carpenter shop, pattern shop and pattern storage house.

From Baltimore, Md., it is learned that plans have been received by J. J. Walsh & Sons for the construction of a car erecting and repairing plant for the Philadelphia, Wilmington & Baltimore Railroad Company at Shellpot, Del., about two miles from Wilmington. Bids were to go in some days ago. The plant will consist of ten buildings. The probable cost to build is about $600,000. The foundation for the plant has been laid. Besides this plant there is to be erected in the near future a forty-four stall roundhouse.

Work has begun on the plant of the Pittsburgh Tool & Drop Forging Company at Chesswick, on the West Penn Railroad. This is a corporation recently formed with a capital of $100,000 for the purpose of manufacturing track and mining tools and specialties in drop forgings and tools of various kinds. The plant is being erected upon a plot of two acres, and when completed will furnish employment to 245 men. The officers of the company are W. F. Scnleiter, president; W. R. Wray, treasurer, and Joseph R. Morris, general manager.

The Standard Plunger Elevator Company is to build a plant at Jamesville, Worcester, Mass. The main building will be 350x100 feet. In addition, there will be buildings for a blacksmith shop, power plant and office. The machinery has been ordered, which will cost $60,000. Contracts aggregating $500,000 have already been booked by the company. The president is William H. Woodin, a vice-president and director of the American Car & Foundry Company. The vice-president is John Sheman Hoyt, of New York. The practical elevator manufacturers in the concern are Worcester men, who recently held positions with the Plunger Elevator Company. They are Fred A. Jones, Matthias B. Wall and Thure Larsson. Mr. Jones is secretary of the new corporation. Mr. Wall will be the superintendent of the shops. The main offices will be at 1 Broadway, New York. The company has opened a temporary office in Worcester, in the Chase building, 44 Front street.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

For Sale—One 21 in. latest improved Gisholt lathe. Box 61, AMER. MACHINIST.

Wanted—Copy Nov. 9, 1899; state price. Address "Bookkeeper," AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book, "Dies and Diemaking," 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

Wanted—Second-hand Pratt & Whitney cutter grinder in good condition. A. F. M. & Bro., 28 Prospect st., Newark, N. J.

Sublet part of hurry contracts to Industrial M. Co., Newark, N. J., or 608 Western ave., Lynn. Parts of machines and light mach'y.

Cheap; 20 horse-power gas engine; Fairbanks, Morse & Co. make; also hangers and pulleys. The Caille Novelty Company, Windsor, Canada.

Oil Engines.—Book by Goldingham; valuable for designers, builders, users of oil or gas engines; $2. Spon & Chamberlain, 123 Liberty, New York.

Castings and blueprints, 5 sizes boat and sta. 2-cycle gasoline engines; also completed engines; tested, successful. Hildreth Motor Co., Lansing, Mich.

For Sale—Iron foundry located within 40 miles of Pittsburgh, Pa.; now running at full capacity and large trade to draw on. Box 104, AMERICAN MACHINIST.

Light and medium machinery built to order; estimates furnished on all kinds of machine work. F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—Light machine work and special machinery to build to order, special tools, dies and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

For Sale—New foundry, completely equipped, 60x380, on Erie Canal and Delaware & Hudson Railroad, near Albany; also complete machine shops and forging plant at Troy. Address Pneumatic Signal Company, Broad Exchange, New York.

Agency wanted for specialties, by established English firm calling on all classes of tool dealers; grinding or polishing materials preferred; American references; principal will be in New York in October. Address Box 99, AMERICAN MACHINIST.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wanted—Men who are thoroughly familiar with the various processes of the manufacture of iron and steel, and who are easy, fluent writers to contribute to a live, up-to-date iron and steel paper; we will pay liberally for contributions of interest and merit. Engineer Publishing Co., Cleveland, Ohio.

A Middle West manufacturer of standard machine tool in extensive use and bearing excellent reputation, wants man acquainted with New York machine tool trade; preferably (not necessarily) one now established and having storeroom; opportunity to represent other good makes; communication confidential. Address Box 96, AMER. MACH.

Germany representation of first-class American firms wanted by German mechanical engineer; advertiser at present in America; will in two months return to Germany and start business at large place in central Germany, very favorably situated for importation; especially good prospects for pneumatic tools, hoisting and conveying machinery. Box 108, AMERICAN MACHINIST.

Foundry for Sale.—Complete plant, in Syracuse, N. Y.; will make castings up to 30,000 lbs.; is adapted for general work; has traveling crane, two cupolas, blower, flasks, etc., and is ready to run; plenty of local work; low price and reasonable terms; also have large machine and boiler shops, same place. Wm. A. Reade & Co., 410 American Trust Bldg., Cleveland, Ohio.

Young man, first-class mechanical and executive ability, good general, all-around machinist, first-class draftsman, familiar with up-to-date foundry practice, wishes to hear of an opportunity where he could invest a few thousand dollars; jobbing shop preferred; would not object to any part of the West, so long as the enterprise is in a locality where business can be secured. Box 94, AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Experienced mechanical draftsman desires position. Box 92, AMERICAN MACHINIST.

Experienced mechanical draftsman wishes to change position. Box 101, AM. MACH.

Draftsman (graduate) with experience wants position. Answer to Box 116, AM. M.

Successful designing draftsman; inventive; reliable; special machinery, tools, etc. Box 22, AMERICAN MACHINIST.

Experienced mechanical draftsman and designer wants position; technical graduate; shop experience. Box 115, AMER. MACH.

Experienced mechanical draftsman, graduated abroad, wants position; engine works preferred. Box 100, AMERICAN MACHINIST.

By one experienced in designing light automatic machinery, also charge manufacture small machines. Box 110, AMER. MACHINIST.

Mechanical draftsman, graduated, experienced in cranes and hoisting machines, wants position. Bror. Grewin, 27 East 1st st., Bayonne, N. J.

Jones & Lamson flat turret lathe expert operator; competent on other turret and screw machines, to operate or take charge. Box 95, AMERICAN MACHINIST.

Practical wood and metal pattern maker on Gates and Globe valves and pumps, also on sand molding machine; have patent on latter. Box 93, AMERICAN MACHINIST.

Technical graduate and draftsman with some shop experience wants position as assistant draftsman in gasoline or steam engine works. Address Box 17, Martinsburg, Ia.

Mechanical man, large acquaintance, desires to represent good machinery line in Chicago; engine hoisting, transmission and conveying machinery or tools. Box 37, AM. M.

Position as master mechanic, chief engineer of manufacturing plant, or an executive position; best of references as to character and qualifications; electrician, mechanic, etc.; state salary. Box 72, AMER. MACHINIST.

By live, up-to-date toolmaker in northern Pacific coast country; can give good reference as to ability to handle toolroom to advantage in plants producing medium and heavy work. Box 10, AMER. MACHINIST.

Position of responsibility, requiring energy and application, wanted by party at present secretary of large manufacturing company; technical graduate, and thoroughly familiar with office administration; best references. Address Box 102, AMERICAN MACHINIST.

A practical machinist of experience in the shop on different classes of work and tools and outside erecting work is open for an engagement and prefers outside erecting work; can furnish the best of reference as to character and ability. Box 50, AMER. MACH.

Wanted—Position, by a thoroughly well posted and competent salesman; accustomed to closing large contracts, familiar with modern machinery and especially adapted to introduce a new line of goods or to open up new territory. Box 98, AMER. MACHINIST.

Mechanical engineer, technical graduate and expert designer, desires change; 8 years' experience as M. E., chief draftsman and superintendent, in power plant installation, power transmission, shop management and design of light, heavy and automatic machinery; best of references. Address Box 71, AM. MACH.

Wanted—Position as assistant to manager or secretary of a manufacturing, industrial, engineering, machinery or electrical concern; correspondent, or other position requiring similar qualifications. Technical graduate; 3 years in shops and drafting room; 8 years of comprehensive office work in a manufacturing business. Box 103, AMER. MACHINIST.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACHINIST.

Position as foreman of toolroom or manufacturing department, by energetic young man having 14 years' experience in general machine work, tools, dies, interchangeable parts, electrical work, drafting; systematic, thorough and practical and a good manager of help; experience with piece and premium systems, cost-accounting, etc. Box 105, AM. M.

Mechanical engineer and technical graduate wishes to make a change; has had 7 years' practical experience in shops manufacturing engines, boilers and conveying machinery, and held positions of head of department and assistant superintendent, and wishes position of general foreman or superintendent; has great energy and can give best of reference. Address Box 114, AMER. MACHINIST.

Thoroughly practical engineer, tool designer, feed and speed man, who has first-rate experience for economical production of repetition work and able to furnish full particulars as to a most successful career as works manager and up-to-date organizer with progressive and modern firms in the north of England and Germany, is open for engagement; age 30; can start at once; willing to go anywhere. Address Box 109, AMERICAN MACHINIST.

Help Wanted.

Machinists—Your designs for patents made by G. M. Mayer, Monadnock, Chicago.

Wanted—A first-class draftsman; experienced in elevator layout work preferred. Box 91, AMERICAN MACHINIST.

Wanted—Non-union molders; good wages and steady employment. Address Ridgway Dynamo & Engine Company, Ridgway, Pa.

Wanted—Two first-class mechanical draftsmen; permanent place with large telephone manufacturing company. Box 106, AM. M.

Machinists, send for free blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—All kinds experienced engineers, draftsmen; send stamp to register; positions open. Cleveland Engineering Agency, Box 71, Station B, Cleveland, O.

A foreman wanted in an up-to-date machine shop employing 200 men; state age, experience and salary expected. The Hill Clutch Co., Cleveland, O.

Wanted—Patternmaker on patterns for light machinery; steady position to the right man. Apply at S. S. White Dental Mfg. Co., Prince's Bay, Staten Island.

Wanted—Bookkeeper and accountant, familiar with latest improved cost system in manufacturing business. Address "Manufacturer," care AMERICAN MACHINIST.

Working toolmaker wanted in Western Pennsylvania; must be posted on milling machine work. Apply, stating wages, to Box 113, AMERICAN MACHINIST.

Wanted—A capable draftsman, graduate mechanical engineer preferred, to act as assistant to our chief draftsman. The Murray Iron Works Co., Burlington, Iowa.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—2 or 3 salesmen who visit manufacturing plants, to sell our tools, either as a side line or exclusively on salary or commission. Address Box 774, Shelton, Conn.

Wanted—Two first-class planer men, two machine hands and two floor men, all thoroughly good mechanics, for medium to heavy work. The Hill Clutch Co., Cleveland, O.

Wanted—Several first-class patternmakers; location western Pennsylvania; write, stating wages, experience, etc.; permanent positions to the right men. Box 84, AMER. MACH.

Wanted—Mechanical draftsman, experienced in rolling mill machinery and general mill construction; give age, reference and salary expected. Box 245, Ansonia, Conn.

Wanted—Local agents in all large cities, to sell a well-known line of steam engines on commission. Address, giving experience and present connections, "East and West," care A. M.

Wanted—At once, two mechanical draftsmen; those having had experience on hydraulic machinery, cranes, punches and shears preferred. Box 97, AMER. MACHINIST.

Wanted—Good armature winders and brass finishers; steady employment and good wages to first-class hands. Apply to Canadian General Electric Co., 8 Queen st., Montreal, Que.

Wanted—By a large manufacturing concern in San Francisco, a competent cost-accountant of experience; state salary and references. Address Risdon Iron Works, San Francisco, Cal.

Master mechanic wanted; thoroughly familiar with mining and electrical machinery; write fully, stating age, experience, names of former employers and salary expected. Address Box 51, AMERICAN MACHINIST.

Superintendent wanted for foundry employing 100 molders; prefer one familiar with pump and gas engine work; good position for capable man; give references and experience in full. Address Box 112, AMER. MACH.

Wanted—Four good machinists for work on weaving and general machinery; steady, light work; good wages; 50 miles from Chicago. Address promptly, with particulars, Western Cane Seating Co., Michigan City, Ind.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—An outside man to sell shafting, pulleys, hangers, etc.; must be experienced and capable of laying out transmission drives; state age, experience, reference and salary expected, or no attention paid to application. Box 111, AMERICAN MACHINIST.

Machine shop foreman in manufactory of engines and threshing machinery, located in Indiana; must be experienced, acquainted with modern methods and able to handle men; in answering give references, experience and salary expected. Box 107, AMER. MACHINIST.

Wanted—By concern building high grade machine tools, location in up-to-date manufacturing city in northwestern Pennsylvania, several first-class planer hands, lathe hands and fitters. Write, stating experience and wages expected, Box 85, AMER. MACHINIST.

Wanted—Experienced machine shop foreman by shop employing about 50 machinists; mill and water wheel work; must be first-class mechanic and capable of handling men to best advantage; permanent position; state age, experience and references. Box 26, A. M.

Wanted—Foreman for a machine shop, located in Brooklyn, employing about 30 hands on light special machinery; a man not over 40 years of age and with first-class general experience is desired. Address, stating age, experience, references and salary expected, White & Co., P. O. Box 672, New York City.

Wanted—Superintendent with up-to-date ideas of manufacturing, for a machine shop employing from 50 to 100 men; must be acquainted with latest shop practice and methods; good executive ability in getting out work and handling men; conversant with foundry management preferred; state age, experience, references and salary; position permanent to good man. Address Box 603, Guelph, Ont.

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Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.

Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Band Saws

American Machinery Co., Grand Rapids, Mich.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Bearing Metal

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Philadelphia, Pa.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Mchry. Co., Tiffin, O.
Reade Mchry. Co., Cleveland, O.

Blocks and Tackles

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers

Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical

Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Bulldozers

National Mchry Co., Tiffin, O.

Carborundum

See Grinding Wheels.

Car Link Machines

National Machy. Co., Tiffin, O.

Castings, Brass and Bronze

Christensen Engineering Co., Milwaukee, Wis.
Miami Brass Wks., Hamilton, O.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Allegheny Fdry. Co., Warren, Pa.

Castings, Steel

Christensen Engineering Co., Milwaukee, Wis.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Uniform Steel Co., Newark, N. J.

Centers, Planer

Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines

Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Conn.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandergrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Wks., Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron ,Ohio.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, Ohio.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, H. G., St. Louis, Mo.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N .J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Russell, R. M., Binghamton, N. Y.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Russell, R. M., Binghamton, N. Y.

Grinding Machines—*Continued*
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grindstones
Cleveland Stone Co., Cleveland, O.
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, aP.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Enginering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Ins. & Insp. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Milling Attachments
Brown & Sharpe Mfg. Co., Providence, R. I.
The Adams Co. Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co. Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.

Patterns, Metal
Great Eastern Metal Pattern Co., New York.

Patterns, Wood
Gardner, H. W., Waukegan, Ill.
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Ct.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Cooke Machinery Co., New York.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co. T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Manchester, N. H.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., Joan, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburg, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Beam Bending Machine.

BY E. C. THULIN.

In the building of small cars that are to be subjected to hard usage, either as contractors' dump cars or conveyors for cinders and slag from a furnace, it is desirable to have as few parts as possible in the construction. Especially is this true of the frame which carries the body, as well as the running gear. The ideal frame for such a car is one that is made from a single I-beam, bent in the form of a rectangle, with the ends meeting on one end, as represented very plainly in Fig. 1, which shows a 3x5-foot frame made from a 7-inch I-beam. To make this frame and eliminate all complications of manufacture requires some ingenuity and skill on the part of the designer of the machinery, not from the standpoint of fine machine work, but as a matter of principle. The writer had occasion to visit a manufacturing plant where such a machine was in operation, in this case bending I-beams to be used as frames for horse-powers that go with threshing outfits. The plan shown has some modifications as to details, as the machine in question was built by cut-and-try methods that showed lack of ability to study the device on paper before constructing it. The machine itself calls for nothing exceptional from a mechanical standpoint, but the results are remarkably accurate and the product leaves the machine in a finished condition.

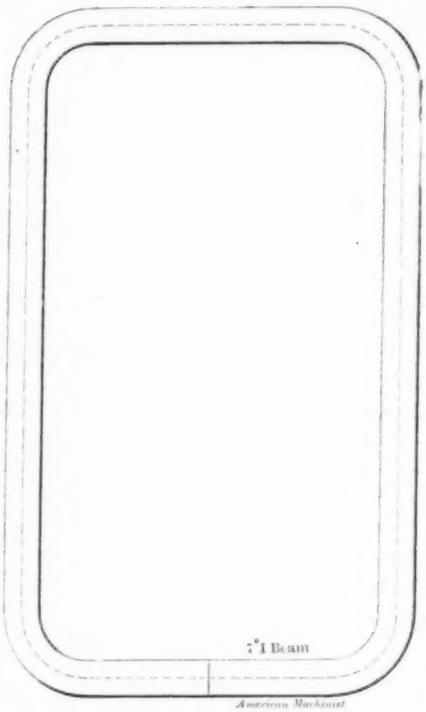


FIG. 1. FRAME FOR A SMALL CAR.

Referring to Figs. 2, 3, 4, 5 and 6, a few explanations will make the operation plain and easily understood. In Fig. 2 is shown a plan of the machine with I-beam in place ready for bending after having been properly heated. The outside line of the view represents the foundation plate which is firmly bolted in place to a brick base built up above the floor about 30 inches. To this plate is bolted a quadrant that does the bending and an arm that holds the beam in place. The small radius of this quadrant corresponds to the curve to be given to the I-beam, while the larger radius for the rope gives the proper leverage for bending the beam. The relation of these parts to each other is more plainly shown in Fig. 4, which is a cross-section on *A A*, Fig. 2. In placing the I-beam in the machine the arm *a* is swung out to the position *a'* indicated by the dotted lines, and after clamping the beam at *B B* and resting it against the roller *C C*, the arm is swung in place and fastened to the common center of the quadrant by a 2-inch pin held firmly in place by a key. This pin must necessarily be removed or dropped into the quadrant to let the arm pass over it in swinging, and provision is made to let the pin down and then raising it again by screwing a rod into the tapped hole in the pin. This may seem crude, but still it is simple and perhaps as good a way as any. After the arm is swung into place, the eccentric *b* with lever handle *c* attached is swung so that a bearing is made against

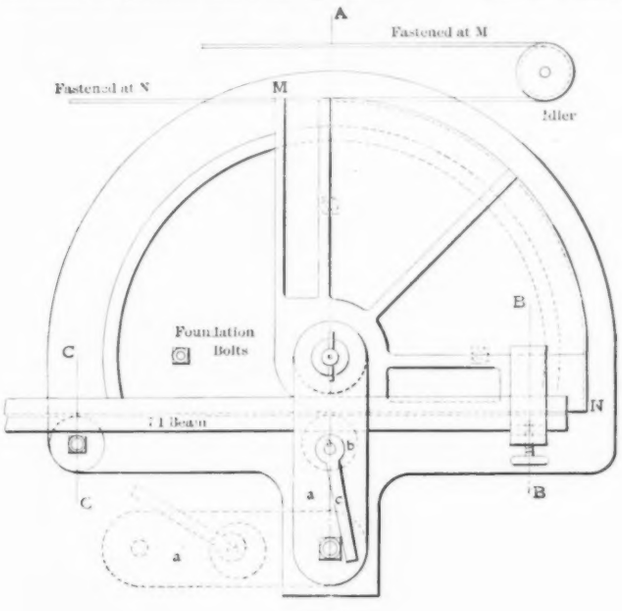


FIG. 2

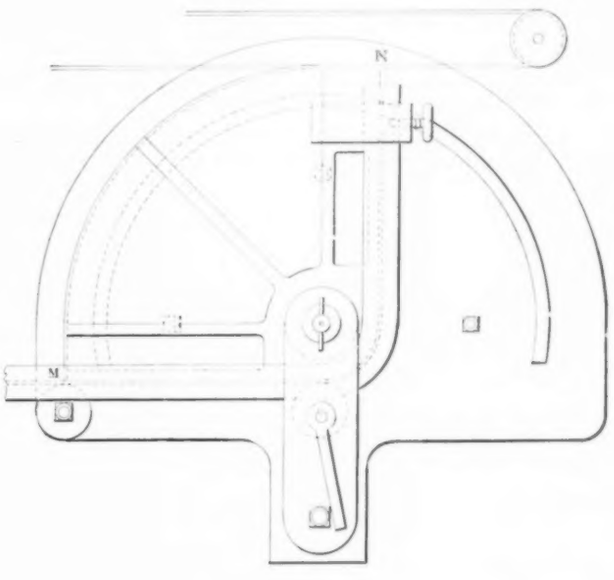


FIG. 3

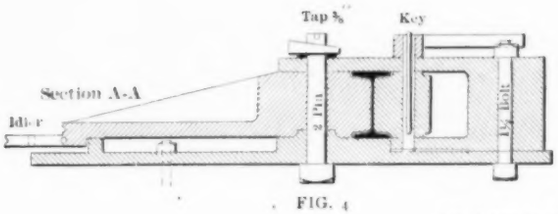


FIG. 4

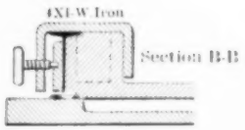


FIG. 5

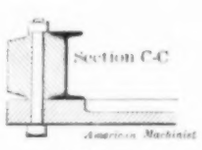


FIG. 6

AN I-BEAM BENDING MACHINE.

the web of the I-beam. As this point is where the bend is to be made, protection must be given the beam to avoid buckling.

The bend is now ready to be made. Two ways suggest themselves for driving the machine: one by a piston and cylinder with cable attached to the quadrant and the second by a geared drum similar to an elevator hoist. This latter device seems the best. The cable is attached at the point *N*, and, after making the right number of turns on the drum, is carried back around the idler and the other end is fastened at *M*. By starting the drum the quadrant is drawn around, carrying the beam with it, forming the desired bend on the die or quadrant. At this point the machine is in the position shown in Fig. 3. By swinging back the arm the beam can be removed and reheated for the next bend. To carry the quadrant back to place for the next operation the drum is reversed, which gives a pull at *M*, the slack cable traveling toward *N*. These two ends of the cable set in two grooves of the quadrant, as is shown in Fig. 4. Other details are represented in Figs. 5 and 6. Fig. 5 is a section on *B B* and shows the clamping device, a small block of iron resting against the I-beam with a U-strap of heavy wrought iron over all and a hand-wheel screw adjustment to hold it in place. A hinged device might have been used, but it is better to avoid any joints in a machine that does such work as illustrated here. Many other features have been omitted in the description, as they speak for themselves in the drawing.

The application of this machine is of interest to only a few readers; still, with some modification, this machine could be applied to advantage to many different operations requiring heavy bending, and no doubt such changes will suggest themselves to the reader.

Fractional Indexing.

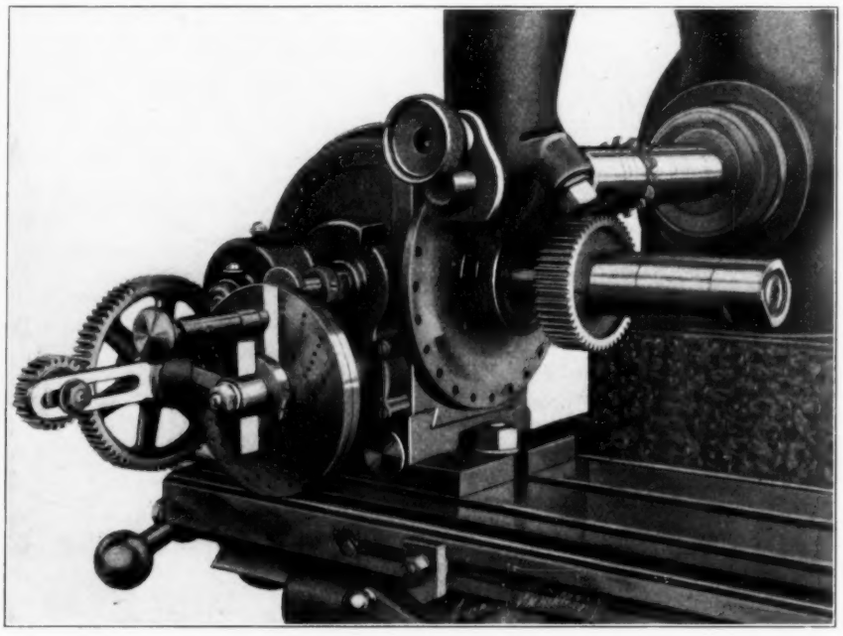
BY C. E. DE PUY.

Several years ago I wished to graduate a segment of a sircle in one-sixth degree, or 2,160 divisions for the complete circle, by the use of a milling machine dividing head, and after trying in vain to use some of the methods of compound indexing described in the AMERICAN MACHINIST about twelve years ago, I was obliged to arrange a method of my own, which I call the fractional method of indexing.

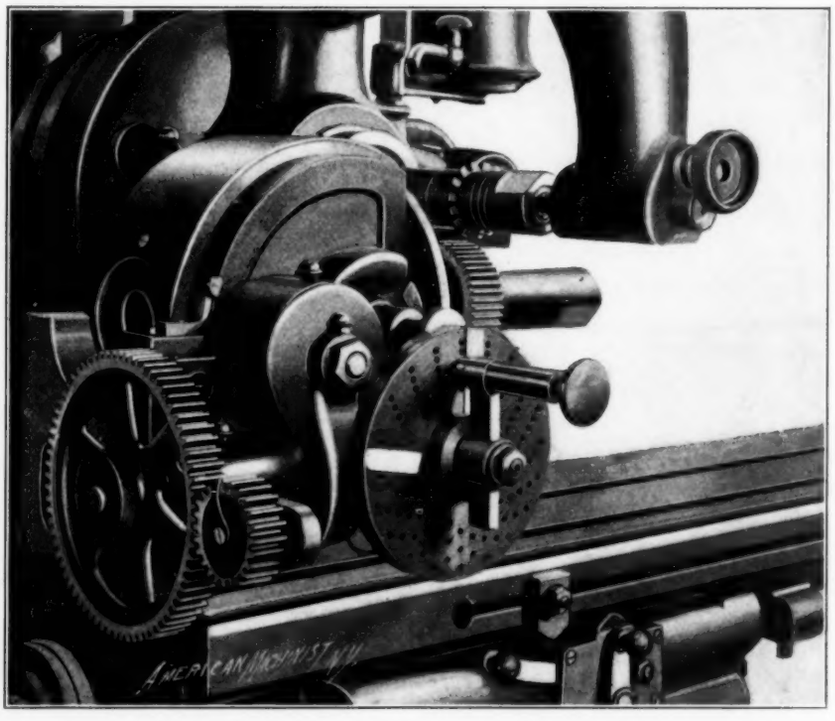
Recently I had to do some more of this same work, and I attempted to use the De Leeuw method, which was discussed in the AMERICAN MACHINIST last year, and explained by Mr. Beal, but I found that I could not apply it to this case without making a special arrangement of the gears, and even then the spindle was confined to a horizontal position, which is inconvenient in this work.

I then concluded that my method still had some merits, and I have since used it in several cases, with entire success. I have also made out an index table, a part of which is here shown, giving all the possible divisions obtainable by this method. The arrangement can be applied to the cutting of bevel gears, or dividing, with the head set in any position. The essential feature is the use of two index circles, one of which gives a means of obtaining a fraction of a space on the other circle. Sometimes only one index plate is used, but generally two are required. Both plates are fastened on with the screws ordinarily used, but to get the two plates on at the same time, I had to face about 1-16 inch off the shoulder of the sleeve carrying the plates and omit the ordinary sector.

To divide a circle into 2,160 parts on the Brown & Sharpe miller it is necessary to move the worm shaft $\frac{40}{2160}$, or $\frac{1}{54}$ of a revolution, for each division; but as 49 is the greatest number of holes on the index plates of the machine, it is necessary to get indirectly the equivalent of this number of holes. $\frac{1}{54}$ is half of $\frac{1}{27}$, and I reasoned that if by some means I could move the index pin half a space on the 27 circle, I should then have the division I desired. This I accomplished by placing the index plate with 20 holes in the outside row on



MILLING MACHINE SET UP FOR FRACTIONAL INDEXING.



MILLING MACHINE SET UP FOR FRACTIONAL INDEXING.

the sleeve first, and then putting on the plate having a circle with 27 holes. The back pin engaged the circle of 20 holes, and the index pin was adjusted to the 27 circle. When both pins were withdrawn and the index plates were moved half a revolution, the back pin again dropped into a hole, but the front pin was halfway between two holes, and a move to the first hole gave the desired half of $\frac{1}{27}$, or $\frac{1}{54}$ of a turn.

To simplify the turning of the index plates, I placed a gear on the shaft which turns the index plates when cutting spirals, and which is called in the milling machine gear table the worm, and another gear on the idler stud, with half as many teeth. A pointer was fastened over this idler, and a tooth was marked to indicate the movement. With both index pins removed, the index plates and gears were free to turn, and a revolution of the idler indicated the proper movement of the plates. This arrangement was simple to apply, easy to operate, and the result was satisfactory.

After graduating the circle it was necessary to graduate a vernier for it, with 40 lines corresponding to 39 on the circle. This would require 2215—$\frac{15}{39}$ divisions to make it exact, but I used 2220. $\frac{39}{2220} = \frac{3}{180} = \frac{1}{60}$, the required movement of the index crank. $\frac{1}{60} = \frac{1}{3} \times \frac{1}{20}$, and $\frac{2}{60} = \frac{2}{3} \times \frac{1}{20}$. To get this I used 33 holes on the back index circle and 37 holes on the front plate. The indicating gears were 3 to 1, and the idler was given one turn, but the plates were turned in the direction opposite to that of the index crank, so that two-thirds of a space was left for the crank movement.

Divisions corresponding to any number divisible into two factors, which are also factors of two index circle numbers, but neither of which is a common factor of both circles, can be obtained by this method.

If, for example, 63 divisions are wanted. First get the factors 7 and 9. 7 is also a factor of 49, and this can be used for the back index circle. 9 is a factor of 18 and this can be used for the front circle. The fractional turn for the index crank is $\frac{40}{7} \times \frac{1}{9}$ or $\frac{80}{7} \times \frac{1}{18}$, which gives a movement for the crank of 11—$\frac{2}{7}$ holes, on the 18 row. $\frac{1}{7} \times 18 = \frac{18}{7} = 2\text{—}\frac{4}{7}$, but $\frac{6}{7} \times 18 = \frac{108}{7} = 15\text{—}\frac{3}{7}$. If, then, the index plates are turned $\frac{6}{7}$ of a revolution, the index pin, which is stationary, will pass by 15—$\frac{3}{7}$ spaces. The 15 spaces are unimportant, but the $\frac{3}{7}$ is the fraction wanted for the crank movement, and a gear of 28 teeth on the worm and one of 24 teeth on the stud will indicate this movement of the plates. Here the movement of the plates is in the same direction as the crank, for the fractional remainder obtained from the movement of the index plates is also the fractional movement for the crank. Sometimes, however, it is more convenient to move the plates in the opposite direction, and use the difference between the fractional remainder and a whole space for the fractional turn of the crank. Take, for example, 77 divisions. The factors are 7 and 11; the fractional turn is $\frac{120}{11} \times \frac{1}{21}$. $\frac{120}{11} = 10\text{—}\frac{10}{11}$, and $\frac{1}{11} \times 21 = 2\text{—}\frac{1}{11}$, but $\frac{1}{11}$ of a turn of the plates is inconvenient to indicate with the gears, and if the plates are turned backward $\frac{10}{11}$ the result is the same, for $\frac{10}{11} \times 21 = \frac{210}{11} = 19\text{—}\frac{1}{11}$, which leaves $\frac{10}{11}$ of a space to turn the crank ahead.

In the table the minus sign before the fractional turn of the plates indicates that the plates are to be moved in the direction opposite to that of the crank.

A number which has a factor common to both index circles cannot be divided by this method. For example, 81 = 3 × 27, and $\frac{1}{3} \times 27 = 9$, so that if the plates are moved $\frac{1}{3}$ of a revolution, the index pin will drop into another hole of the 27 circle, and nothing is gained by using the two plates.

Number of Divisions	Fractional Turn of Crank	Holes on Outside Plate: Number in Circle	Holes on Outside Plate: Move	Number of Holes on Inside Plate	Fractional Turn of Plates	Gear on: Worm	Gear on: Stud	Rev. of Stud Gear
51	$\frac{40}{51} \times \frac{1}{17}$	17	13—$\frac{1}{3}$	33	—$\frac{7}{33}$	72	24	1
57	$\frac{40}{57} \times \frac{1}{19}$	19	13—$\frac{1}{3}$	33	+$\frac{7}{33}$	72	24	1
63	$\frac{40}{63} \times \frac{1}{18}$	18	11—$\frac{8}{9}$	49	+$\frac{8}{49}$	28	24	1
69	$\frac{40}{69} \times \frac{1}{23}$	23	13—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
77	$\frac{120}{77} \times \frac{1}{21}$	21	10—$\frac{10}{11}$	33	—$\frac{10}{33}$	44	40	1
87	$\frac{40}{87} \times \frac{1}{29}$	29	13—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
93	$\frac{40}{93} \times \frac{1}{31}$	31	13—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
96	$\frac{40}{96} \times \frac{1}{16}$	16	6—$\frac{2}{3}$	33	—$\frac{2}{33}$	72	24	1
99	$\frac{40}{99} \times \frac{1}{18}$	18	7—$\frac{2}{11}$	33	+$\frac{2}{33}$	44	24	$\frac{1}{2}$
102	$\frac{40}{102} \times \frac{1}{17}$	17	6—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
111	$\frac{40}{111} \times \frac{1}{37}$	37	13—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
112	$\frac{40}{112} \times \frac{1}{16}$	16	5—$\frac{8}{9}$	49	+$\frac{8}{49}$	28	24	1
114	$\frac{40}{114} \times \frac{1}{19}$	19	6—$\frac{2}{3}$	33	—$\frac{2}{33}$	72	24	1
119	$\frac{40}{119} \times \frac{1}{17}$	17	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	32	1
123	$\frac{40}{123} \times \frac{1}{41}$	41	13—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
126	$\frac{40}{126} \times \frac{1}{18}$	18	5—$\frac{8}{9}$	49	+$\frac{8}{49}$	56	24	1
129	$\frac{40}{129} \times \frac{1}{43}$	43	13—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
133	$\frac{40}{133} \times \frac{1}{19}$	19	5—$\frac{8}{9}$	49	—$\frac{8}{49}$	28	24	1
138	$\frac{40}{138} \times \frac{1}{23}$	23	6—$\frac{2}{3}$	33	+$\frac{2}{33}$	72	24	1
141	$\frac{40}{141} \times \frac{1}{47}$	47	13—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
147	$\frac{40}{147} \times \frac{1}{49}$	49	13—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
154	$\frac{40}{154} \times \frac{1}{21}$	21	5—$\frac{8}{11}$	33	+$\frac{8}{33}$	44	24	1
161	$\frac{40}{161} \times \frac{1}{23}$	23	5—$\frac{8}{9}$	49	+$\frac{8}{49}$	28	24	1
174	$\frac{40}{174} \times \frac{1}{29}$	29	6—$\frac{2}{3}$	33	+$\frac{2}{33}$	72	24	1
175	$\frac{40}{175} \times \frac{1}{15}$	15	3—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	24	1
176	$\frac{40}{176} \times \frac{1}{16}$	16	3—$\frac{8}{11}$	33	+$\frac{8}{33}$	44	32	1
186	$\frac{40}{186} \times \frac{1}{31}$	31	6—$\frac{2}{3}$	33	—$\frac{2}{33}$	72	24	1
187	$\frac{40}{187} \times \frac{1}{17}$	17	3—$\frac{7}{11}$	33	+$\frac{7}{33}$	44	24	$\frac{1}{2}$
189	$\frac{40}{189} \times \frac{1}{27}$	27	5—$\frac{8}{9}$	49	+$\frac{8}{49}$	28	24	$\frac{1}{2}$
192	$\frac{40}{192} \times \frac{1}{16}$	16	3—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
198	$\frac{40}{198} \times \frac{1}{18}$	18	3—$\frac{7}{11}$	33	—$\frac{7}{33}$	44	40	1
203	$\frac{40}{203} \times \frac{1}{29}$	29	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	40	1
204	$\frac{40}{204} \times \frac{1}{17}$	17	3—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
208	$\frac{40}{208} \times \frac{1}{39}$	39	7—$\frac{1}{4}$	20	+$\frac{1}{20}$	48	24	1
209	$\frac{40}{209} \times \frac{1}{19}$	19	3—$\frac{7}{11}$	33	+$\frac{7}{33}$	44	40	$\frac{1}{2}$
217	$\frac{40}{217} \times \frac{1}{31}$	31	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	32	1
222	$\frac{40}{222} \times \frac{1}{37}$	37	6—$\frac{2}{3}$	33	—$\frac{2}{33}$	72	24	1
224	$\frac{40}{224} \times \frac{1}{16}$	16	2—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	24	1
228	$\frac{40}{228} \times \frac{1}{19}$	19	3—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
231	$\frac{40}{231} \times \frac{1}{33}$	33	5—$\frac{8}{9}$	49	—$\frac{8}{49}$	28	24	1
238	$\frac{40}{238} \times \frac{1}{17}$	17	2—$\frac{4}{7}$	49	+$\frac{4}{49}$	28	24	$\frac{1}{2}$
246	$\frac{40}{246} \times \frac{1}{41}$	41	6—$\frac{2}{3}$	33	—$\frac{2}{33}$	72	24	1
252	$\frac{40}{252} \times \frac{1}{18}$	18	2—$\frac{8}{9}$	49	+$\frac{8}{49}$	56	40	1
253	$\frac{40}{253} \times \frac{1}{23}$	23	3—$\frac{7}{11}$	33	+$\frac{7}{33}$	44	28	1
255	$\frac{40}{255} \times \frac{1}{17}$	17	2—$\frac{2}{3}$	33	—$\frac{2}{33}$	72	24	1
258	$\frac{40}{258} \times \frac{1}{43}$	43	6—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
259	$\frac{40}{259} \times \frac{1}{37}$	37	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	28	24	1

Number of Divisions	Fractional Turn of Crank	Holes on Outside Plate: Number in Circle	Holes on Outside Plate: Move	Number of Holes on Inside Plate	Fractional Turn of Plates	Gear on: Worm	Gear on: Stud	Rev. of Stud Gear
266	$\frac{40}{266} \times \frac{1}{19}$	19	2—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	32	1
272	$\frac{40}{272} \times \frac{1}{17}$	17	2—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	24	1
273	$\frac{40}{273} \times \frac{1}{39}$	39	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	24	1
275	$\frac{40}{275} \times \frac{1}{15}$	15	2—$\frac{8}{11}$	33	+$\frac{8}{33}$	44	24	1
276	$\frac{40}{276} \times \frac{1}{23}$	23	3—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
282	$\frac{40}{282} \times \frac{1}{47}$	47	6—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
285	$\frac{40}{285} \times \frac{1}{19}$	19	2—$\frac{4}{7}$	33	—$\frac{4}{33}$	72	24	1
287	$\frac{40}{287} \times \frac{1}{41}$	41	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	28	24	$\frac{1}{2}$
288	$\frac{40}{288} \times \frac{1}{18}$	18	2—$\frac{1}{4}$	20	+$\frac{1}{20}$	48	24	1
294	$\frac{40}{294} \times \frac{1}{49}$	49	6—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
297	$\frac{40}{297} \times \frac{1}{27}$	27	3—$\frac{7}{11}$	33	+$\frac{7}{33}$	44	32	1
301	$\frac{40}{301} \times \frac{1}{43}$	43	5—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	40	1
304	$\frac{40}{304} \times \frac{1}{19}$	19	2—$\frac{1}{4}$	20	+$\frac{1}{20}$	48	24	1
308	$\frac{40}{308} \times \frac{1}{21}$	21	2—$\frac{8}{11}$	33	+$\frac{8}{33}$	44	32	1
310	$\frac{40}{310} \times$	31						
312	$\frac{40}{312} \times$	39						
315	$\frac{40}{315} \times \frac{1}{27}$	27	3—$\frac{1}{3}$	49	+$\frac{1}{49}$	56	32	1
319	$\frac{40}{319} \times \frac{1}{29}$	29	3—$\frac{7}{11}$	33	—$\frac{7}{33}$	44	40	1
320	$\frac{40}{320} \times$	16						
322	$\frac{40}{322} \times \frac{1}{23}$	23	2—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	24	1
328	$\frac{40}{328} \times$	41						
329	$\frac{40}{329} \times \frac{1}{47}$	47	5—$\frac{4}{7}$	49	—$\frac{4}{49}$	28	24	1
330	$\frac{40}{330} \times$	33			+$\frac{1}{3}$			
336	$\frac{40}{336} \times \frac{1}{21}$	21	2—$\frac{1}{4}$	20	+$\frac{1}{20}$	48	24	1
340	$\frac{40}{340} \times$	17						
341	$\frac{40}{341} \times \frac{1}{31}$	31	3—$\frac{7}{11}$	33	+$\frac{7}{33}$	44	24	$\frac{1}{2}$
344	$\frac{40}{344} \times$	43						
345	$\frac{40}{345} \times \frac{1}{23}$	23	2—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
348	$\frac{40}{348} \times \frac{1}{29}$	29	3—$\frac{1}{3}$	33	—$\frac{1}{33}$	72	24	1
350	$\frac{40}{350} \times \frac{1}{15}$	15	1—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	40	1
352	$\frac{40}{352} \times \frac{1}{16}$	16	1—$\frac{8}{11}$	33	+$\frac{8}{33}$	44	32	$\frac{1}{2}$
360	$\frac{40}{360} \times$	18						
364	$\frac{40}{364} \times \frac{1}{39}$	39	4—$\frac{4}{7}$	49	+$\frac{4}{49}$	56	32	1
368	$\frac{40}{368} \times \frac{1}{23}$	23	2—$\frac{1}{4}$	20	+$\frac{1}{20}$	48	24	1
370	$\frac{40}{370} \times$	37						
372	$\frac{40}{372} \times \frac{1}{31}$	31	3—$\frac{1}{3}$	33	+$\frac{1}{33}$	72	24	1
374	$\frac{40}{374} \times \frac{1}{17}$	17	1—$\frac{7}{11}$	33	+$\frac{7}{33}$	44	28	1
376	$\frac{40}{376} \times$	47						
378	$\frac{40}{378} \times \frac{1}{27}$	27	2—$\frac{4}{7}$	49	—$\frac{4}{49}$	28	24	1
380	$\frac{40}{380} \times$	19						
384	$\frac{40}{384} \times \frac{1}{16}$	16	1—$\frac{8}{9}$	33	—$\frac{8}{33}$	72	24	1
385	$\frac{40}{385} \times \frac{1}{21}$	21	2—$\frac{8}{11}$	33	—$\frac{8}{33}$	44	24	$\frac{1}{2}$
390	$\frac{40}{390} \times$	39						
392	$\frac{40}{392} \times$	49						
396	$\frac{40}{396} \times \frac{1}{18}$	18	1—$\frac{8}{9}$	33	+$\frac{8}{33}$	44	24	1
400	$\frac{40}{400} \times$	20						

The fractional turns obtainable by the back plate are halves, thirds, quarters, fifths, sevenths, elevenths, thirty-thirds and forty-ninths, and the number of divisions that may be obtained range from 51 to 64,680.

The sector, ordinarily used for counting holes on the index plates, cannot be used when both plates are on, and I made one with sheet-steel arms, each arm being riveted to a collar. One of these collars fits the index-plate sleeve, and the other fits the outside of the first collar, and is split so as to clamp on it. One of the arms has the end bent over, forming a spring resting on the outside of the index plate, which holds the sector in place after it is adjusted.

When this sector is in use, the index plates are first moved and then locked, as has been described. The front pin is then released and allowed to rest against the plate, for it is not in the right position to enter a hole, one arm of the sector is moved into contact with the pin, and then the other arm indicates the hole to which the pin is to be moved.

The photographs show a 51-tooth gear on the spindle, and the head adjusted to make that number of divisions.

In some cases the idler gear can have more than one tooth marked, so as to obtain $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, or other required part of a revolution, and by this means all the movements required in the table given can be obtained with gears belonging to the machine, with the single addition of a 44, and this I have on one of the lathes in the shop.

Lewis Institute, Chicago.

Anchors for Crane Chains—Casting Hoisting Drums.

BY G. E. FLANAGAN.

Fig. 1 shows the wrong way of fastening the chain to the hoisting drum of a traveling crane. This is a method of securing the chain very commonly practiced, but the fault lies in drilling the hole for the spur of the chain anchor in the groove, in place of through solid metal beyond the chain groove as shown in Fig. 2. There is only a slight difference between these two methods, but the first subjects the anchor spur to a bending stress several times greater than is done by the second, and may cause the failure of the connection, while the difference in cost between the right and the wrong way is too small to be mentioned. Crane drums should of course always be so proportioned that from one-half to a full coil of chain will remain upon the drum with the hook in the lowest position in which it is possible for it to sustain a load, and in this case only a fraction of the full stress will come upon the anchor; but although this requirement may be observed when the machine is first installed, conditions may be changed afterwards, as by digging deeper pits in the foundry, and thus the entire load may come directly upon the chain anchor, which ought to be fully capable of meeting such an emergency. It will be noted that Fig. 2 requires a link of extra length on the end of the chain in order to reach the spur in the position shown. Figs. 1 and 2 are both open to the objection that the drum may be rotated far enough to bring the pull of the claim as shown in dotted lines of Fig. 2. In this case the load will not come upon the spur at all, but principally upon the nearest tap bolt, and it will be increased by a leverage depending upon the distance from the chain to this bolt. A better arrangement than either is shown in Fig. 3, and it has the advantage of being cheap and easily made. It consists simply of a round rod, threaded on each end for nuts and then bent to the required radius. The holes drilled in the drum must be parallel to each other, not radial. The center line through the anchor should be a radial line. There is little tendency for the nuts to work loose, but jamb nuts are used notwithstanding, as it is better to be on the safe side. They may be replaced by split pins if preferred. On some special types of cranes, designed for working under a practically uniform load, a part of the combined weight of the load and tongs is balanced by a counterweight, the chain from which is wound upon the drum as that to which the load is attached is unwound; and, conversely, is unwound while the load is being raised. For this purpose Fig. 3 makes a good anchor if made wide enough to admit a link of each chain. Balancing part of the load on these cranes renders the work upon the motor more nearly uniform, and calls for less gripping force on the brake to hold the load from running down. It is especially useful when the tongs and the mechanism for operating them are of great weight in proportion to the load which they are designed to carry. This weight being balanced, the crane, when empty, will operate as freely when raising as when lowering, leaving almost the full power of the motor to work against the extraneous load.

Crane drums must be made strong enough to serve as beams supported at each end and carrying the full chain load in the center, the length of the beam being considered, not as the length of the drum merely, but as the distance from center to center of the shaft bearings. This is not strictly true except for certain cases, but it is approximately correct for most forms of construction, for it is obvious that if the shaft deflects it brings a bending stress upon the drum in the same direction as that produced upon it directly by the chain load. The smaller drums are made solid and cast upon the shaft which has a keyseat planed or mill d in it to become filled with iron to prevent the possibility of the drum slipping. Sometimes a series of shallow holes are drilled in the shaft to answer the same purpose, but they are not as effective, since the metal does not

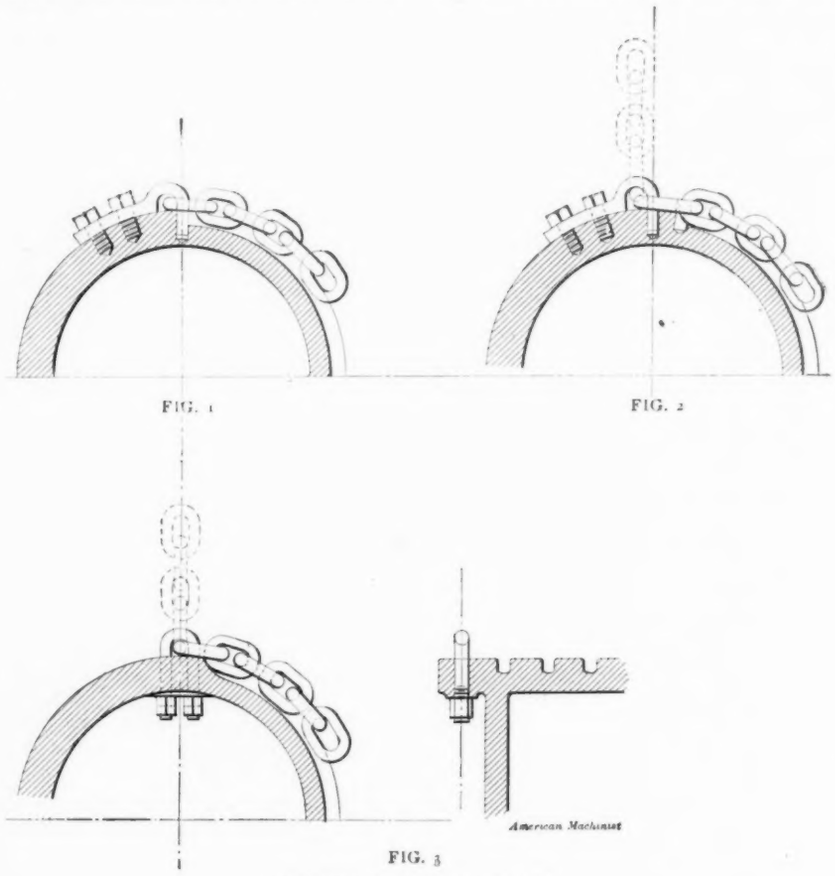


FIG. 1 FIG. 2

FIG. 3

ANCHORS FOR CRANE CHAINS.

always so completely fill the holes and the keys thus formed may become loosened and broken one at a time. If used, they should be drilled close together so as to run into each other and then be chipped out to form a continuous groove. Larger drums are cast hollow, connecting to the shaft by a hub at each end. The keyseat should then be in one hub only, and the shaft should be coated where the second hub occurs to prevent the iron from sticking and allow the drum to slip lengthwise upon it when cooling, for the reason that the shaft being cold when the metal is poured will not shrink along with it, and internal strains are caused sufficient to impair the strength of the casting, or even to crack it before it leaves the foundry. In a drum of any considerable length this is a matter of too great importance to be neglected. When the driving gear is attached directly to the drum, it makes little difference at which end the keyseat is placed, but if the driving force is to be transmitted through the shaft, it should always be placed at the end of the drum next to the gearing, making the distance from the driving gear to the key through which the shaft drives as short as possible, thus reducing the spring of the shaft to a minimum. Drums from which severe work is expected should not be cast upon the shaft except when the driving force is applied directly to the drum itself, leaving only the force necessary to overcome the friction of the bearings to be transmitted through the shaft. This makes much the better form of hoisting drum for heavy loads and high speeds, as the constant jerking of the drum, applying its force at the pitch radius of the drum, tends to loosen any connection which can be made at a radius only equal to that of the shaft. The strength of the joint which is made in the foundry is always an unknown quantity, and even if we neglect the friction between the parts entirely and place dependence only upon the iron forming a key in the shaft, we can never be sure that the groove is completely filled and that there will not be sufficient lost motion to render the construction useless. One serious fault with this form of connection is that if found to be imperfect it is almost impossible to do anything to improve it, as the shaft cannot be removed. A better design is one in which a steel feather is fitted securely to the shaft in place of leaving the groove in it to be filled with iron. This makes the key of steel, a much stronger metal than cast iron, and the iron is more certain to flow closely around it than to fill a groove or a series of holes. If the feather is made to extend entirely through the drum hub, it would then be possible to force the shaft out of the drum in case it becomes loose, and the drum could then be bored out and a larger shaft inserted and keyed in place. When the driving must be done through the shaft, it is better to design the drum to be bored out in the first instance, and pushed on to a tightly fitting shaft and supplied with properly fitted keys. The rough shaft to be cast in a hollow drum should not be less than ½ inch larger than the finished diameter of the journals, and when finishing, the drum should be centered by the casting to preserve this of a uniform thickness. If the shaft has only a scraping of finish allowed and happens to have been placed slightly eccentric in the mold, the lathe hand will work to the shaft center and will turn more than the due allowance from one side of the casting. The ordinary crane drum is sufficiently weakened by cutting the chain grooves, but this is a condition which is unavoidable, and is the very reason why every precaution should be taken to in other respects preserve the strength of the casting.

On the detail drawings crane drums are usually shown in section, sometimes accompanied by an outside view and sometimes not. If correctly drawn on the section, the thread or groove will appear the reverse of what is shown on the outside view, and is liable to lead to error on the part of any but the most careful workman, a right-hand thread being mistaken for a left-hand one. Where the section only is given, it is well to mark the groove right hand or left hand, as the case may be.

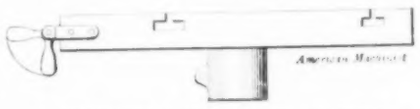
A Suggested Improvement in Drill Presses.

BY FERD. WERTHEIM.

A machinist, wishing to do rapid, satisfactory drilling, is usually severely handicapped when the work is to be done on an upright drill press, the difficulty being to get the center of the hole in line with the center of the spindle.

This difficulty, as experienced on small, accurate work, was shown by the letter of "Drill Hand," at page 1252, Vol. 24, and by Mr. De Leeuw, at page 324, current volume. On the radial the trouble used to be common enough, but it has been eliminated in the newer types, having ball bearings for the arm.

When the bicycle industry caused such



A SUGGESTED IMPROVEMENT IN DRILL PRESSES.

improvement in machine-shop methods, some important alterations were made to the upright drill, chief among which were a stronger drive, stiffer arm and table, and slots large enough to take the ordinary bolts. A recent improvement, which has by no means met with general favor, is a ball thrust bearing for the spindle. On plain work, it is quite the practice to use the upright drill as a boring machine (and it makes an efficient one), but if it is equipped with ball-bearing spindle, and used in this way, it will chatter horribly. On jig work, or on small work easily reclamped, I have no fault to find with the upright drill, nor have I any fault to find with a driller having a compound table, as made by our foreign cousins, or by Gould & Eberhardt in this country.

But let us look at the large amount of heavy work done on these machines, work in which several holes are, or ought to be, drilled at the same setting or clamping. Here the operator must pull and push the heavy arm, and twist the heavy table, always stiff and bulky enough of themselves, but now supplemented by a casting weighing perhaps a ton. Then, when the job has been coaxed beneath the drill, the operator must grope beneath the table for a lever to clamp it in place. Ease of operation is essential, not so much on account of the operator, but because in this case ease of operation means good work, and the usual performance means lots of wasted time or poor work. Nor does the matter end here. Poor driller work means poor work, or wasted effort, or both, when it comes to assembling.

I would suggest the following: First, let the radial or short arm, or semi-radial, supplant the upright drill. Second, improve the upright drill as follows: Let the arm be mounted on a ball or roller bearing—there are several ways to put such a bearing between the arm and the raising device. Third, on upright drillers having tables of about 2 feet diameter, attach a clamping handle to the table, as shown in the illustration, and, when designing drillers with larger tables, put ball or roller bearings beneath table as well as arm.

Practical Copper Welding.

We have received from Mr. Charles Hudson, manager of the National Lathe Tool Company, Ansonia, Conn., a very practical and convincing example of copper welding. The sample consists of a chain of eight twisted links of welded copper apparently as uniform in size and shape and as perfect in the weld as ever found in hand-made iron chain. The wire of which the chain is made is ⅛ inch in diameter and the outside length of the link is 1 inch. Mr. Hudson says of this chain: "I made it on a large forging anvil and with my regular forging hammer in an open blacksmith's fire. The welding is done in exactly the same manner as welding wrought iron. I have adopted this work to various needs; the welds are genuine and solid throughout and will stand as much strain as will any other part of the work. I do not use any flux, compound, acid or anything different from welding wrought iron. My practice in welding copper, as in anything else, is to get a proper heat; this only comes by a close observance of the requirements. I make no secret of it at all. Many people have watched me weld copper, but I have as yet failed to see 'the other fellow' do it. I made this chain, as you see, without missing a link, then missed the next one

and stopped. I have made a good deal of chain for use on pickle tubs, copper rings of large size, etc."

A Brick Lined Steel Smokestack.

The accompanying illustrations show a smokestack of 180 feet total hight, which has recently been constructed by the California Boiler Works, of San Francisco, for the Selby Smelting & Refining Company, of Selby, Cal., from designs by H. R. Jones, chief engineer of the Selby Company.

The stack stands on solid rock, the concrete base being made of smelter slag and going down to low tide level On account of the tide rising to within 4 feet of the surface of the ground it was impracticable to locate the smoke flue below the ground, and the flue openings are hence located in the brick pedestal. Of these openings there are two on opposite sides, but, for the present, one of them is bricked up. The stack is to take the fumes from blast, roasting and reverberatory furnaces.

The stack is lined with 9 inches of fire brick throughout. To allow for expansion, the brick lining is kept ½ inch from the plates with occasional clots of mortar between bricks and plates. The 2-inch foundation bolts extend through the pedestal and about 7 feet into the concrete base.

The stack is self-sustaining without guys, and is calculated to safely withstand a wind pressure of 100 miles per hour, although the highest recorded velocity in the vicinity is 60 miles per hour.

Following are a few leading particulars from the specifications:

Extreme hight, exclusive of pedestal—160 feet.

Internal diameter of cylindrical portion of shell—11 feet 7 inches.

Hight of flared base—20 feet.

Diameter of flared base—20 feet.

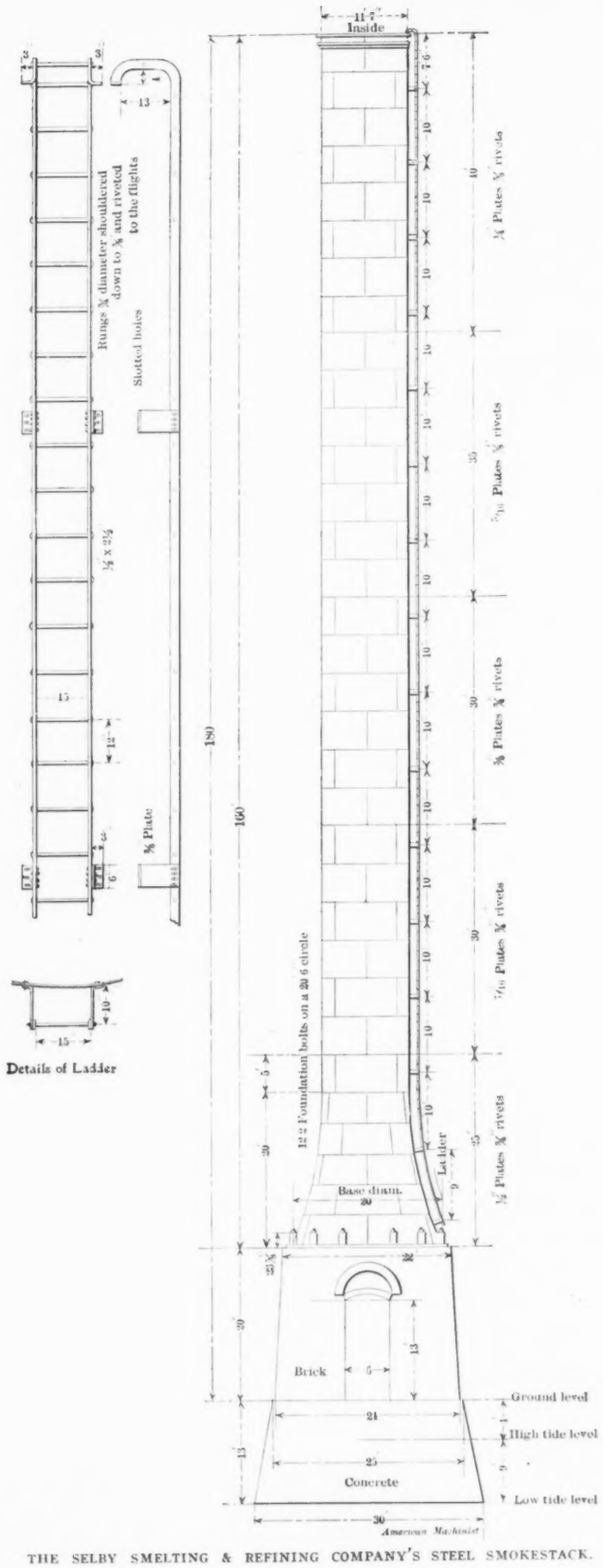
Thickness of plates—25 feet of ½ inch, 30 feet of 7-16 inch, 30 feet of ⅜ inch, 35 feet of 5-16 inch, 40 feet of ¼ inch.

The upper end of each course of plates goes *inside* the lower end of the next course above. All girth seams below the ¼-inch plates and all vertical seams in the flare are double riveted; all vertical seams above the flare and all girth seams in the ¼-inch plates are single riveted.

Following are some of the leading weights:

	Pounds.
Foundation	981,500
Brick pedestal	630,784
Brick lining	525,596
Steel stack	102,702
Ironwork	18,881
Total	2,259,463

A friend wishes to know something of the history of blanking and drawing presses; that is, when, where and by whom they were first used, and any other facts that might be interesting regarding their earliest employment.



THE SELBY SMELTING & REFINING COMPANY'S STEEL SMOKESTACK.

A Method for Making Exact Computations.

BY GEO. F. SUMMERS.

By far the greater part of a draftsman's calculations need to be carried to only three figures, and may be performed advantageously on a slide-rule. There is, however, an occasional demand for exact work, especially in the making of tables, or base figures, upon which other work depends, and for laying down such precise work this system may be used.

The method here given is based on the following principles:

(a) Mistakes occur most frequently in work that requires mental effort, and in any large piece of work one is warranted in using ways that are easiest, which generally reduces down to some system in which the work consists in transcribing and adding.

(b) Then, in transcribing, the figures taken by the eye from one place and put by the hand into another frequently get transposed, which is a worry to all bookkeepers, and to avoid which some means should be devised.

(c) By the ordinary way of multiplication a great many duplications occur which all cost time and money and might be avoided by performing the computation once and copying the result when needed.

(d) Also in multiplying, many figures are put down and then thrown away. One can economize by not putting down the figures which are not going to be used.

(e) In adding it takes effort to keep the figures in columns and in line, and mistakes occur from a confusion in the work. A system should overcome this difficulty.

(f) Mistakes occur from mistaking one figure for another.

To use principle (a), division is performed by using the reciprocal and multiplying, and multiplication is done by making a table of each of the nine numerals multiplied into the multiplier.

For an illustration it will be assumed that some draftsman in his work is required frequently to divide some quantity, which may be called n, by the square root of 2, the result to be accurate to five figures.

The required answer

$$= \frac{n}{\sqrt{2}} = n \times \frac{1}{\sqrt{2}} = n\sqrt{.5} = .7071068\,n,$$

working out the square root by arithmetic to seven places, because we wish to throw away two places in the answer as not being exact.

The decimal will be transferred in the following manner: A piece of paper with a straight edge, Fig. 1, is placed directly above the number and the figures copied across to the new paper. They are in the same manner transferred in pencil from the paper to the center of a clean sheet. The two lines of figures are then added without moving away the paper, as in Fig. 2.

The paper is now moved down one line and added again as in Fig. 3.

After nine additions we will have Fig. 4. If the work is correct the tenth line will be the same as the slip with the decimal point moved once to the right. It is better, however, not to consider the decimal point in multiplication but point off the finished result by another method.

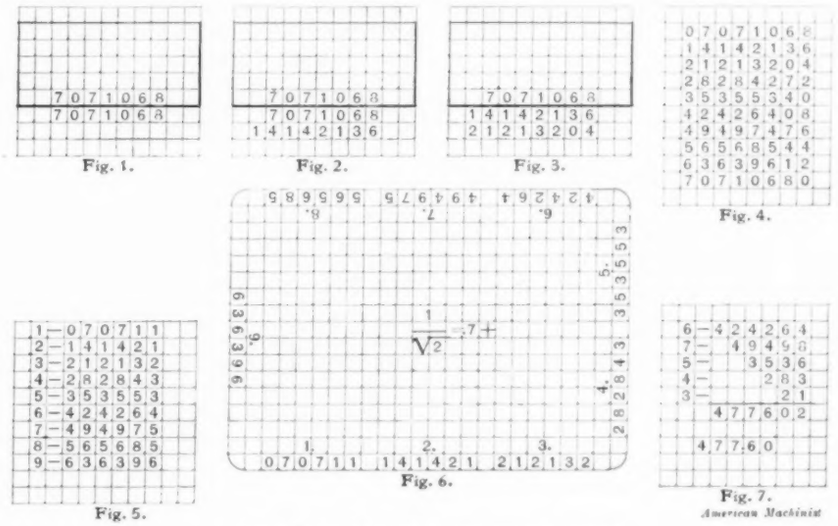


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7.

American Machinist

A METHOD OF MAKING EXACT CALCULATIONS.

Ciphers are filled in on the left edge of the table where needed, and index figures as shown. The pencil figures are now written over in drawing ink, the last two places being thrown away and the third place being increased one whenever the discarded figures amount to 50 or over. Our table now looks like Fig. 5.

Now transfer this table in drawing ink (without using a pencil) to the edges of a sheet of paper, Fig. 6. This is the finished table for use whenever it is required to divide any quantity by the square root of 2.

To use this table we will proceed directly to an example without description, as being the simpler mode of explanation.

Suppose it is required at any time to divide 675.43 by the square root of 2. Write the quantity vertically, Fig. 7, and transcribe from the table the proper figures, as shown, and add, taking care to throw the last figure to one higher when the discarded figure is 5 or over.

To find the decimal place, we see by inspection that $675 \times .7 =$ about 500, therefore our answer is 477.60.

To keep the figures in order it is best to use ruled cross-section paper of about one-sixth or one-eighth to the inch, a figure occupying one square.

To avoid mistaking the figures they should be made where possible with drawing ink or with a medium pencil with a sharp point, each figure being made slowly and deliberately. It pays to make good figures, even when it takes a considerably longer time to put them down.

With the table once made, division can be done easily and rapidly without the liability of error.

Test of an Elevator Air Cushion.

A test was recently made of the air cushion provided for the elevator of the tower in the City Hall at Philadelphia. The elevator car, which is about 5 feet square, was drawn to the top of the shaft and given a free drop to the bottom, the actual distance traveled being 381 feet. On the bare floor of the car were placed a considerable number of eggs, about fifty incandescent lamp bulbs and boxes containing half a dozen rats. A few of the eggs were cracked but not broken and no other injurious results were discoverable. The depth of air cushion proper was 84 feet. The distance which the car fell could not be equaled in this country, except in the elevators in the Washington monument.

An air cushion is a most simple and obvious safety device for an elevator, and the wonder is that it is not more generally if not universally employed. Probably the deterrent consideration in most cases is as to the cost of it. The first thought of the air cushion is of something added to and entirely distinct from the shaft in which the car normally travels. We think of an excavation to be made, of considerable depth, with the interior carefully trued and smoothed and with the bottom of the car fitted to it like a piston in a steam cylinder. Then we are apt to think a little further in the same direction, and the additional objection is found that on account of the elasticity of the air and the fit of the piston the car, when it drops, will jump up and down for a considerable time, coming to rest at last according to the friction that may still be operative between the car and the walls of the cushion chamber. As a matter of fact both these objections are unfounded. No excavation is required, as the lower portion of the shaft as actually used is perfectly available for the cushion chamber. It is only necessary to have the interior reasonably true and smooth, and where doors occur to have them practically tight, with the certainty that they will always be closed

when the car is away from them. The length of cushion chamber usually provided is from one-fifth to one-sixth of the total travel of the car. The car, or the bottom of it, does not require to be a perfectly air-tight fit, as the cushion action required is so sudden that the air has not the time to escape. In fact, means are provided for the escape of a portion of the confined air in the cushion chamber when arresting the descent of the car, and this escape is at a gradually decreasing rate from the entrance of the car at the top of the chamber until within, say, one-fourth of the depth of the chamber from the bottom. The most obvious and simplest means for the graduated escape of the air is a vertical taper slot in the side of the chamber, widest at the top and coming to a point at, say, a quarter of the distance from the bottom. The same effect may obviously be provided by slightly tapering or enlarging the upper portion of the chamber, either all around or on one side, or even on a portion of one side. In the lower part of the chamber an escape valve is provided, with an adjustable spring by which the limit of pressure may be regulated. An inwardly opening or vacuum valve allows the car to rise freely after its descent. The means provided for the escape of the air when the car drops obviously kill entirely its tendency to rebound; it comes to rest gradually, and when it stops the air escapes before it has time to rise again. The sides of the cushion chamber must obviously be braced or strengthened to safely stand the pressure within, and the cost of applying the air cushion is of course less if provided for in the original construction and arrangement of the building than if added at a later time. The elevator in the Philadelphia tower referred to above was installed by the Ellithorpe Safety Air-Cushion Company, of New York.

Technical Education.

We have in the past given considerable attention to the very original and decided opinions of Professor John Perry on technical education. He recently made an extended address on that subject before the Engineering Section of the British Association for the Advancement of Science which affords quite as much food for thought as anything that he has previously said. He is a radical of radicals in his views regarding the necessity for reform in these matters. We are, however, greatly embarrassed in attempting to apply many of his statements to American conditions, as we have too little knowledge of English educational methods to be able to judge how far his strictures apply to American methods. It does not seem to us that American education is quite so much a matter of tradition and formalism as the methods to which he refers so slightingly. Latin is not used here as the foundation of the study of English, as he says it is in England, and the study of geometry, or Euclid, as they call it in England, is not, as we recall it, such a dreary expenditure of time as Professor Perry describes it. We therefore omit these portions of his address, as it is impossible to say how far they apply to American schools. Much of the address is, however, of universal application and is so full of obvious common sense that we regret the necessity for condensing these portions of it at all. We are, however, compelled to limit ourselves to the following extracts:

"I do not want to speak of boys in general. I want only to speak of the boy who may become an engineer, and before speaking of his training I want to mention his essential natural qualification—that he really wishes to become an engineer. I take it to be a rule to which there are no exceptions that no boy ought to enter a profession—or, rather, to continue in a profession—if he does not love it. We all know the young man who thinks of engineering things during office hours, and never thinks of them outside office hours. It is true, family influence may perhaps get such a man a better position, but he will never be an engineer. He is not fit even to be a hewer of wood and drawer of water to engineers. Love for his profession keeps a man alive to its interests all his time, although, of course, it does not prevent his taking an interest in all sorts of other things as well; but it is only a professional problem that warms him through with enthusiasm. I think we might assume that there never yet was an engineer worth his salt who was not fond of engineering, and so I shall speak only of the education of the young man who is likely to be fond of engineering.

"I want to say at the outset that I usually care only to speak of the average boy, the boy usually said to be stupid, 95 per cent. of all boys. Of the boy said to be exceptionally clever, I need not speak much. Even if he is pitchforked into works immediately on leaving a bad school it will not be long before he chooses his own course of study and follows it, whatever course may have been laid down for him by others.

"I had already been an appprentice for four years at the Lagan Foundry when I entered Queen's College for a course of civil engineering. I suppose that there never was on this earth a college so poorly equipped for a course of engineering study. Even the lecture room—this lecture room in which you are now sitting—was borrowed from the physics professor. There was a narrow passage, ironically called a "drawing room," and this was the only space reserved for engineering in a town whose engineering work was even then very important. There were some theodolites and levels and chains for surveying, but nothing else in the way of apparatus. But there was as professor a man of very great individuality; he acted as president to this section twenty-eight years ago. I can hardly express my obligations to Professor James Thomson. It was my good fortune to be a pupil both of this great man and of his younger brother, Lord Kelvin, as well as of Dr. Andrews. To come in contact with any of them, even for a little while, as a student, altered forever one's attitude to Nature. It was not that they gave us information, knowledge, facts. The syllabuses of their courses of study were nothing like so perfect as that of the smallest German polytechnic. And yet, if a youth with a liking for physical science had gone to a German gymnasium to the age of nineteen, and had become a walking encyclopædia on leaving one's polytechnic at the age of twenty-four, the course of that life-study would not have done for him as much good as was done by a month's contact with one of these men. People call it 'personal magnetism,' and think there is something occult about it. In truth, they revealed to the student that he himself was a man, that mere learning was unimportant, that one's own observation of some common phenomena might lead to important results unknown to the writers of books. They made one begin to think for oneself for the first time. Let me give an example of how the thing worked.

"James Thomson was known to me as the son of the author of my best mathematical books, but more particularly as the man who had first used Carnot's principle in combination with the discovery of Joule, and I often wondered why Rankine and Clausius and Kelvin got all the credit of the discovery of the second law of thermodynamics. Men think of this work of his merely as having given the first explanation of regelation of ice and the motion of glaciers. He was known to me as the inventor of the Thomson Turbine and Centrifugal Pump and Jet Pump. His name was to be found here and there in all my text-books, always in connection with some thoroughly well-worked-out investigation, as it is to be found in all good text-books now; for wherever he left a subject, there that subject has remained until this day; nobody has added to it or found a mistake in it. He was to me a very famous man, and yet he treated me as a fellow-student. One of his early lectures was about flowing water, and he told us of a lot of things he had observed which I also had observed without much thought; and he showed how these simple observations completely destroyed the value of everything printed in every text-book on the subject of water flowing over gage notches, even in the otherwise very perfect Rankine. I felt how stupid I had been in not having drawn these conclusions myself, but in truth till then I had never ventured for a moment to criticise anything in a book. I have been a cautious critic of all statements in text-books ever since. If any engineer wants to read what is almost the most instructive paper

that has ever been written for engineers, let him refer to the latest paper written by James Thomson on this subject. The reasoning there given was given to me in lectures in this very room in 1868, and had been given to students for many years previous.

"Again, soon afterwards he let me see that although I had often looked at the whirlpool in a basin of water when the central bottom hole is open, and although I had read Edgar Allen Poe's mythical description of the maelstrom, I had been very much too careless in my observation. Among other things, Thomson had observed that particles of sand gradually passed along the bottom towards the hole. When he found out the cause of this, it led him at once to several discoveries of great importance. Indeed, the study of this simple observation gave rise to all works on (1) what occurs at bends of pipes and channels, and why rivers in alluvial plains bend more and more; (2) the explanation of the curious phenomena that accompany great forest fires; (3) the complete theory of the great wind circulation of the earth, published in its final form as the Bakerian Lecture of the Royal Society of 1892.

"When a boy or man of any age or any kind of experience enters an engineering college, and wishes to learn the scientific principles underlying a trade or profession, how ought we to teach him? Here is the reasonable general principle which Professors Ayrton and Armstrong and I have acted upon, and which has so far led us to much success. Whether he comes from a bad or a good school, whether he is an old or young boy or man, approach his intelligence through the knowledge and experience he already possesses. This principle involves that we shall compel the teacher to take the pupil's point of view rather than the pupil the teacher's; give the student a choice of many directions in which he may study; let lectures be rather to instruct the student how to teach himself than to teach him; show the student how to learn through experiment, and how to use books; and, except for suggestion and help when asked for, leave him greatly to himself. If a teacher understands the principle, he will have no difficulty in carrying it out with any class of students. I myself prefer to have students of very different qualifications and experience in one class, because of the education that each gives to the others.

"It was for such boys that the courses of instruction at the Finsbury Technical College were arranged twenty-two years ago. It was attempted to supply that kind of training which ought already to have been given at school, together with so much technical training as might enable a boy at the end of a two years' course to enter any kind of factory where applied science was important, with an observing eye, an understanding brain and a fairly skillful hand. A boy was taught how he must teach himself after he entered works. If after two or three years in the works he cared to go for a year or so to one of the greater colleges, or did not care, it was assumed that he had had such a training as would enable him to choose the course which was really the best for him.

Old Finsbury students are to be found everywhere in important posts. The experiment has proved so successful that every London Polytechnic, every Municipal technical school in the country, has adopt d the system; and in the present state of our schools I feel sure that all important colleges ought to adopt the Finsbury system. It hardly seems appropriate to apply the word "system" to what was so plastic and uncrystallized, and had nothing to do with any kind of ritual.

"The professors were given a free hand at Finsbury, and there were no outside examiners. I need not dwell upon the courses in chemistry and physics; some critics might call the subjects 'rational chemistry' and 'applied physics'; they were as different from all other courses of study in these subjects as the courses on rational mathematics and mechanics differed from all courses elsewhere. The course on mechanics was really one on mechanical engineering. There were workshops in wood and iron, not to teach trades, but rather to teach boys the properties of materials. There were a steam engine and a gas engine, and shafting and gearing of many kinds, and dynamos which advanced students in turn were allowed to look after under competent men. There was no machine which might not be experimented with occasionally. Elementary and advanced courses of lectures were given; there was an elaborate system of tutorial classes, where numerical and squared paper exercise work was done; there were classes in experimental plane and solid geometry, including much graphical calculation; boys were taught to make drawing-office drawings in pencil only, and tracings and blueprints, such as would be respected in the workshop, and not the ordinary drawing-class drawings, which cannot be respected anywhere; but the most important part of the training was in the laboratory, in which every student worked, making quantitative experiments. An offer of a 100-ton testing machine for that laboratory was made, but refused; the advanced students usually had one opportunity given them of testing with a large machine, but not in their own laboratory. I consider that there is very little educational value in such a machine; the student thinks of the great machine, and not of the tiny specimen. Junior students loaded wires and beams, or twisted things with very visible weights and saw exactly what was happening, or they studied vibrating bodies. Many hours were devoted to experiments on a battered, rusty old screw-jack, or some other lifting machine, its efficiency under many kinds of load being determined, and students studied their observations, using squared paper, as intently as if nobody had ever made such experiments before. There was one piece of apparatus, an old flywheel, bought at a rag-and-bone shop, to which kinetic energy was given by a falling weight, which I remember occupied the attention of four white-headed directors of electric companies in 1882 (evening students) for many weeks. A casual first measurement led on to corrections for friction and stiffness of a cord, and much else of a most interesting kind. At the end of six weeks these gentlemen had gained a most thorough computational acquaintance with every important principle of mechanics, a knowledge never to be forgotten. They had also had a revelation such as comes to the true experimenter—but that is too deep a subject.

"Perhaps teachers in the greater colleges will smile in a superior way when they hear of this kind of experimental mechanics being called engineering laboratory work. True, it was elementary mechanics; but is not every principle which every engineer constantly needs called a mere elementary principle of mechanics by superior persons? I find that these elementary principles are very much unknown to men who have passed through elaborate mathematical studies of mechanics. Students found out in that laboratory the worth of formulas; they gained courage in making calculations from formulas, for they had found out the extent of their own ignorance and knowledge.

"At Finsbury there was an excellent one-cylinder engine with vaporizing condenser. It drove the workshops and electric generators. On a field-day it drove an electric generator only, and perhaps thirty students made measurements. Each of them had already acted as stoker and engine driver, as oiler and tester of the machinery, lighting fires, taking indicator diagrams, weighing coals, opening and closing cocks from 7 in the morning to 10 at night, so that everything was well known to him. They maintained three different steady loads for trials of three hours each. They divided into groups, one from each group ceasing to take a particular kind of observation every ten minutes and removing to another job. All watches were made to agree, and each student noted the time of each observation. These observations were: Taking indicator diagrams, checking the speed indicator, taking temperature of feed water, quantity of feed by meter (the meter had been carefully checked by gage-notch, and every other instrument used by us had been tested weeks before), taking the actual horse-power passing through a dynamometer coupling on the shaft, taking boiler and valve-chest pressures and vacuum pressures on the roof and in the engine-room, weighing coals (the calorific value had

already been tested), taking the horsepower given out by the dynamo, counting the electric lamps in use, and so on. Each student was well prepared beforehand. During the next week he reduced his own observations, and some of the results were gathered on one great table. One lesson that this taught could never be forgotten—how the energy of 1 pound of coal was disposed of. So much up the chimney or by radiation from boiler or steam jacket and pipes; in condensation in the cylinder; to the condenser; in engine friction; in shaft friction, etc. I cannot imagine a more important lesson to a young engineer than this one taught through a common working engine. The students had the same sort of experience with a gas engine. I need hardly say how important it was that the professor himself should take charge of the whole work leading up to, during and after such a field-day.

"The difficulty about all laboratory exercise work worth the name is that of finding demonstrators and assistants who are wise and energetic. Through foolishness and laziness the most beautiful system becomes an unmeaning routine, and the more smoothly it works the less educational it is. In England, just now, the curse of all education is the small amount of money available as wages of teachers—just enough to attract mediocre men.

"The electrical engineer has an enormous advantage over other engineers; everything lends itself to exact calculation, and a completed machine or any of its parts may be submitted to the most searching electrical and magnetic tests, since these tests, unlike those applied by other engineers, do not destroy the body tested. But for this very reason, as a finished product, the electrical engineer cannot have that training in the exercise of his judgment in actual practical work after he leaves a college that some other engineers must have. In tunneling, earthwork and building, in making railways and canals, the engineer is supremely dependent on the natural conditions provided for him, and these conditions are never twice the same. There are no simple laws known to use about the way in which sea and river currents will act upon sand and gravel, and engineers who have had to do with such problems are continually appealing to Nature, continually making observations and bringing to bear upon their work all the knowledge and habits of thought that all their past experience has given them. I do not know that there is any job which a good teacher would have greater pleasure in undertaking than the arrangement of a laboratory in which students might study for themselves such problems as come before railway, canal, river, harbor and coast-protection engineers. There is no such laboratory in existence at the present time, and in any case it could only be of use in the way of mere suggestion to an engineer who had already a good knowledge of his profession.

"It was a curious illustration of mental inertia that the usual engineering visitor, even if he was a professor of engineering, always seemed to suppose that the work done at Finsbury was the same as that done in all the great engineering colleges. As a matter of fact, no subject was taught there in the same manner as it was taught elsewhere.

"Most of the students were preparing for electrical or mechanical engineering, and therefore we thought it important that nearly every professor or demonstrator or teacher should be an engineer. I know of nothing worse than that an engineering student should be taught mathematics or physics or chemistry by men who are ignorant of engineering, and yet nothing is more common in colleges of applied science. The usual courses are only suitable for men who are preparing to be mere mathematicians, or mere physicists, or mere chemists. Each subject is taken up in a stereotyped way, and it is thought quite natural that in one year a student shall have only a most elementary knowledge of what is to the teacher such a great subject. The young engineer never reaches the advanced parts which might be of use to him; he is not sufficiently grounded in general principles; his whole course is only a preliminary course to a more advanced one, which there is no intention of allowing him to pursue, and, not being quite a fool, he soon sees how useless the thing is to him. The professor of chemistry ought to know that until a young engineer can calculate exactly by means of a principle, that principle is really unknown to him.

"Mathematics and physics and chemistry are usually taught in water-tight compartments, as if they had no connection with one another. In an engineering college this is particularly bad. Every subject ought to be taught through illustrations from the professional work in which a student is to be engaged. An engineer has been wasting his time if he is unable to answer the questions of an ordinary examination paper in chemistry or pure mathematics. The usual mathematical teacher thinks most of those very parts of mathematics which to an ordinary man who wants to *use* mathematics are quite valueless, and those parts which would be altogether useful and easy enough to understand he never reaches; and, as I have said, so it is also in chemistry. Luckily, the physics professor has usually some small knowledge of engineering; at all events, he respects it. When the pure mathematician is compelled to leave the logical sequence which he loves to teach mechanics, he is apt scornfully to do what gives him the least trouble—namely, to give as 'mechanics' that disguised pure mathematics which forms 90 per cent. of the pretence of theory to be found in so many French and German books on machinery. As pure mathematical exercise work, it is even meaner than the stupid exercises in school algebras; as pretended engineering it does much harm, because a student does not find out its futility until after he has gone through it, and his enthusiasm for mathematics applied to engineering problems is permanently hurt. But how is a poor mathematical professor who dislikes engineering, feeling like Pegasus harnessed to a common wagon—how is he to distinguish good from evil? He fails to see how worthless are some of the books on 'Theoretical Mechanics,' written by mathematical coaches to enable students to pass examinations. An engineer teaching mathematics would avoid all futilities; he would base his reasoning on that experimental knowledge already possessed by a student; he would know that the finished engineer cannot hope to remember anything except a few general principles, but that he ought to be able to apply these, clumsily or not, to the solution of any problem whatsoever. Of course, he would encourage some of his pupils to take up Thomson and Tait, or Rayleigh's 'Sound,' or some other classical treatise as an advanced study.

"Not only do I think that every teacher in an engineering college ought to have some acquaintance with engineering, but it seems to me equally important to allow a professor of engineering, who ought, above all things, to be a practical engineer, to keep in touch with his profession. A man who is not competing with other engineers in practical work very quickly becomes antiquated in his knowledge; the designing work in his drawing office is altogether out of date; he lectures about old difficulties which are troubles no longer; his pupils have no enthusiasm in their work, because it is merely academic and lifeless; even when he is a man distinguished for important work in the past, his students have that kind of disrespect for his teaching which makes it useless to them. If there is fear that too much well-paid professional work will prevent efficiency in teaching, there is no great difficulty in applying a remedy.

"No right-thinking engineer has been scared by the newspaper writers who tell us of our loss of supremacy in manufacture; but I think that every engineer sees the necessity for reform in many of our ways, and especially in this of education. People talk of the good done to our workmen's ideas by the strike of two years ago; it is to be hoped that the employers' ideas were also expanded by their having been forced to travel and to see that their shops were quite out of date. In fact, we have all got to see that there is far too much unskilled labor among workmen and foremen and managers, and especially in owners. There may be some kinds of manufacture so standardized that everything goes like a wound-up clock, and no thought is needed anywhere; but certainly it is not in any branch of engineering.

Many engineering things may be standardized, but not the engineer himself. Millions of money may build up trusts, but they will be wasted if the unskilled labor of mere clerks is expected to take the place of the thoughtful skilled labor of owners and managers. I go further, and say that no perfection in labor-saving tools will enable you to do without the skilled, educated, thoughtful, honest, faithful workman with brains. I laugh at the idea that any country has better workmen than ours, and I consider education of our workmen to be the cornerstone of prosperity in all engineering manufacture. It is from him in countless ways that all hints leading to great inventions come.

"In the last twenty-three years I have written a good deal about the harm done to England by the general dislike that there is among all classes for any kind of education. I do not say that this dislike is greater than it used to be in England; I complain that it is about as great. But I have never spoken of the decadence of England. It is only that we have been too confident that those manufactures and that commerce and that skill in engineering, for which Napoleon sneered at us, would remain with us forever. Many writers have long been pointing out the consequences of neglecting education; prophesying those very losses of trade, that very failure of engineers to keep their houses in order, which now alarms all newspaper writers. Panics are ridiculous, but there is nothing ridiculous in showing that we can take a hint. We have had a very strong hint given us that we cannot forever go on with absolutely no education in the scientific principles which underlie all engineering.

"And now I want to call your attention to a new phenomenon. Over and over again has attention been called to the fact that the engineer has created what is called 'modern civilization,' has given luxuries of all kinds to the poorest people, has provided engines to do all the slave labor of the world, has given leisure and freedom from drudgery, and chances of refinement and high thought and high emotion to thousands instead of units. But he is doing things more striking still. Probably the most important of all things is that the yoke of superstitions of all kinds on the souls of men should be lifted. The study of natural science is alone able to do this, but education through natural science for the great mass of the people, even for the select few called the distinguished men of the country, has been quite impossible till recently. I say that it is to engineers that the world owes the possibility of this new study becoming general. In our country nearly all discoveries come from below. The leaders of science, the inventors, receive from a thousand obscure sources the germs of their great discoveries and inventions. When every unit of the population is familiar with scientific ideas, our leaders will not only be more numerous, but they will be individually greater. And it is we, and not the schoolmasters, who are familiarizing the people with a better knowledge of Nature.

"All the heart-breaking preaching of enthusiasts in education would produce very little effect upon an old society like that of England if it were not for the engineer. He has produced peace. He is turning the brown desert lands of the earth into green pastures. He is producing that intense competition among nations which compels education. If England has always been the last to begin reform, she has always been the most thorough and steadfast of the nations on any reform when once she has started on it. Education, pedagogy, is a progressive science; and who am I that I should say that the system of education advocated by me is that which will be found best for England? In school education of the average boy or man England has as yet had practically no experience, for she has given no real thought to it. Yet when she does, I feel that although the Finsbury scheme for engineers may need great improvement, it contains the germ of that system which must be adopted by a race which has always learned through trial and error, which has been led less by abstract principles or abstract methods of reasoning than any race known in histo.y."

A New English Form of Lathe Bed.

We clip the accompanying illustrations from the *Mechanical Engineer*, of Manchester, England. They represent a new form of lathe bed designed by James Brockie. Fig. 1 represents a lathe of which the carriage has no gibs, and Fig. 2 shows the form of gib applied to the front side of the carriage.

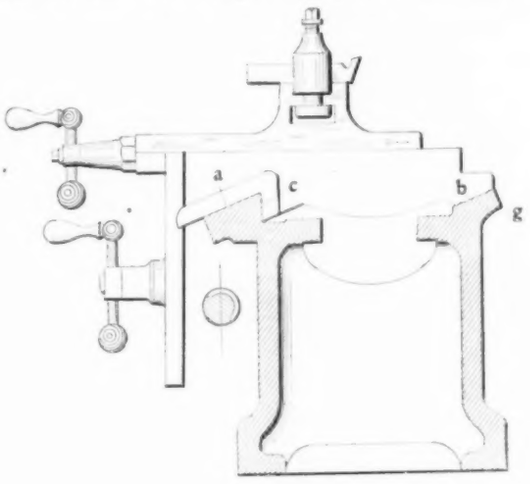


Fig. 1.

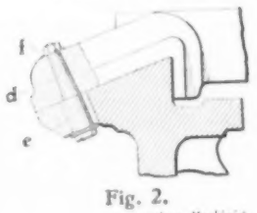


Fig. 2.

BROCKIE'S LATHE BED.

The guiding surfaces for the carriage will be seen from Fig. 1 to consist of two parallel inclined surfaces *a b* and a vertical surface *c*. The inclination of surfaces *a* and *b* is such that the carriage tends to slide down them by the force of gravity, while the surface *c* is vertical and no amount of horizontal pressure due to the cut can give the carriage a tendency to lift on the guiding surfaces.

The gib construction shown in Fig. 2 is interesting because of the means provided for adjustment. The taper bolt *d* has a cylindrical eccentric end *e* in the gib. To adjust the gib it is only necessary to turn the bolt in its seat, after which tightening the nut *f* will obviously secure the parts firmly in position. If the back side of the carriage is to have a gib, the rear wing of the carriage is made to surround the rear guide of the bed and the gib is made to bear upon the surface *g* of Fig. 1, the taper eccentric bolt of Fig. 2 being again used for adjustment.

High Pressure Fluid Discharge Computer.

At page 401 we published an article by Wm. Cox, of 25 Broad street, New York, on the "Flow of Natural Gas in Pipes," in which he compared the formula which is much used in connection with natural gas mains with one developed by J. E. Johnson, Jr., at page 689 of Vol. 22, for compressed air. After making allowance for the difference in the specific gravity of the two gases, Mr. Cox found a very satisfactory agreement between the formulas—in fact, the difference was found to be scarcely more than microscopic. These formulas, we should add, are analytically correct, as they take into account the reduced pressure and the consequent increased velocity as the gas traverses the pipe. Where the loss of pressure is considerable, as it always is in natural gas pipe lines, allowance for this action is essential. Formulas which do not provide for it may, it is true, be used by treating the pipe in sections and making repeated application of the formula to the various sections in succession; but, in addition to the clumsiness of this method, it is only roughly accurate, as in each section the action described is ignored and the error

is always on the wrong side. If the discharge is assumed and the loss of pressure is calculated, the loss found is always too small, and if the loss is assumed and the discharge is calculated, the discharge found is always more than the pipe will give.

The fact that the same formula, by the introduction of a factor for the specific gravity, becomes applicable to such different cases as air and natural gas makes it feasible to construct one of Mr. Cox's well-known computers, which, by a suitable edge graduated for specific gravity, becomes applicable to gases of all specific gravities within the range provided.

Mr. Cox has sent to us one of his computers, which, being in general construction similar to those for other purposes which we have shown several times in the past, it seems scarcely necessary to show by a special engraving. We may, however, say that it is only necessary to set the specific gravity of the gas against the length of the pipe and the loss of the pressure against the sum of the initial and final pressures, when, against the diameter of the pipe, is read the cubic feet of gas discharged.

Two Old Lathes Combined to Make a Rotary Planer.

BY JOSEPH MENEGUS.

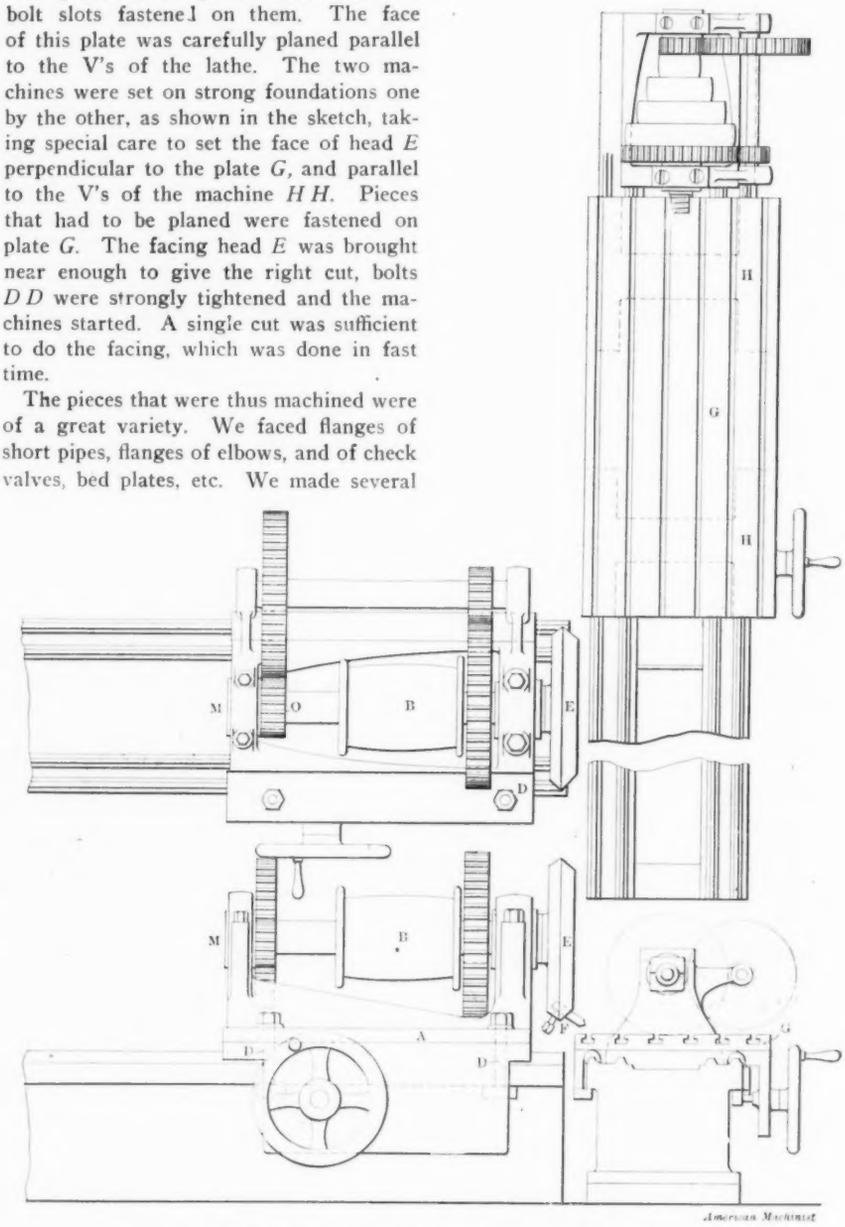
There were two old lathes down the shop that occupied valuable space without turning out a reasonable amount of work. They were old-style lathes, had spindles too small, cone pulleys too narrow, and tailstock and carriage out of proportion with the beds. Bad machines when new, and almost useless then, because of the cross-feeds being out of order, the spindles out of line, the rack teeth broken, etc. Sam, the apprentice boy, used to take one for facing off when our facing machine was too busy, and the other, a long bed machine, was used for filing and straightening long shafts.

We had a lot of facing to do, and were contemplating buying a new planer and putting the two old lathes entirely out of commission, to make room for the new machine, when I worked out the scheme illustrated in the enclosed blueprint. It saved the cost of a new tool, and made of the two old and useless lathes a useful and remarkably good combination.

We started by removing the spindle and cone pulley from the larger machine, and replaced them with a far larger spindle and one single wide pulley. This pulley *B* and pinion *O* were keyed to a quill that fitted loosely on the spindle. The large gear and the boxes were bored to suit the new spindle.

The carriage was faced on top, and a parallel plate *A* bolted on. The headstock of the lathe was bolted to plate *A*, as shown. Four bolts *D D* were used to fasten the carriage at any desired place. On one end of the spindle at *M* was an arrangement, not shown in the sketch, for taking up any slackness caused by the end thrust, and a head *E*, bearing a large number of tools *F*, was fitted on the other end of the spindle. The diameter of pulley *B* was such as to give to the tools *F* a reasonable cutting speed. The driving pulley was long enough to take care of the displacement of the carriage *A*. The two carriages *H H* of the other machine were planed and a plate *G* provided with bolt slots fastened on them. The face of this plate was carefully planed parallel to the V's of the lathe. The two machines were set on strong foundations one by the other, as shown in the sketch, taking special care to set the face of head *E* perpendicular to the plate *G*, and parallel to the V's of the machine *H H*. Pieces that had to be planed were fastened on plate *G*. The facing head *E* was brought near enough to give the right cut, bolts *D D* were strongly tightened and the machines started. A single cut was sufficient to do the facing, which was done in fast time.

The pieces that were thus machined were of a great variety. We faced flanges of short pipes, flanges of elbows, and of check valves, bed plates, etc. We made several jigs for facing slide valves, thin covers and bars, etc. In one word, the machine was kept going all the year round; in fact, there wasn't in the place a busier and more productive machine.



A ROTARY PLANER MADE FROM TWO OLD LATHES.

American Goods in English Markets.

Judging by an extended review in *Engineering* for September 5, a useful and perhaps even an important book, entitled "The American Invaders," by F. A. McKenzie, has just appeared in England. There has been a great deal of foolish and alarmist talk in some English journals which, according to *Engineering*, have "overlooked really serious matters and exaggerated the purely trivial in order to create a sensation."

The present author, according to our contemporary, aims at and fairly succeeds in "stating the facts without exaggerating or minimizing American industrial triumphs." The various industries are treated in order, and the book appears to be the result of much original research. It will no doubt be of interest to American as well as English readers.

A Solar Motor.

A practical solar motor is in use on an ostrich farm at South Pasadena, Cal. It is rated at about 15 horse-power, and cost approximately $2,500. The reflector, which suggests a large inverted umbrella, is 32 feet in diameter and its axis is arranged to

automatically point to and follow the sun. The sun's rays reflected from the parabolic interior surface are focused in rings upon a slim cylindrical boiler in the center. At a test 192 pounds of water per hour was evaporated under a pressure of 150 pounds. The steam is used for pumping and 1,400 gallons of water per minute was delivered with a lift of 12 feet. In a land blessed with reliable sunshine this would seem to be preferable to a windmill.

Letters From Practical Men.

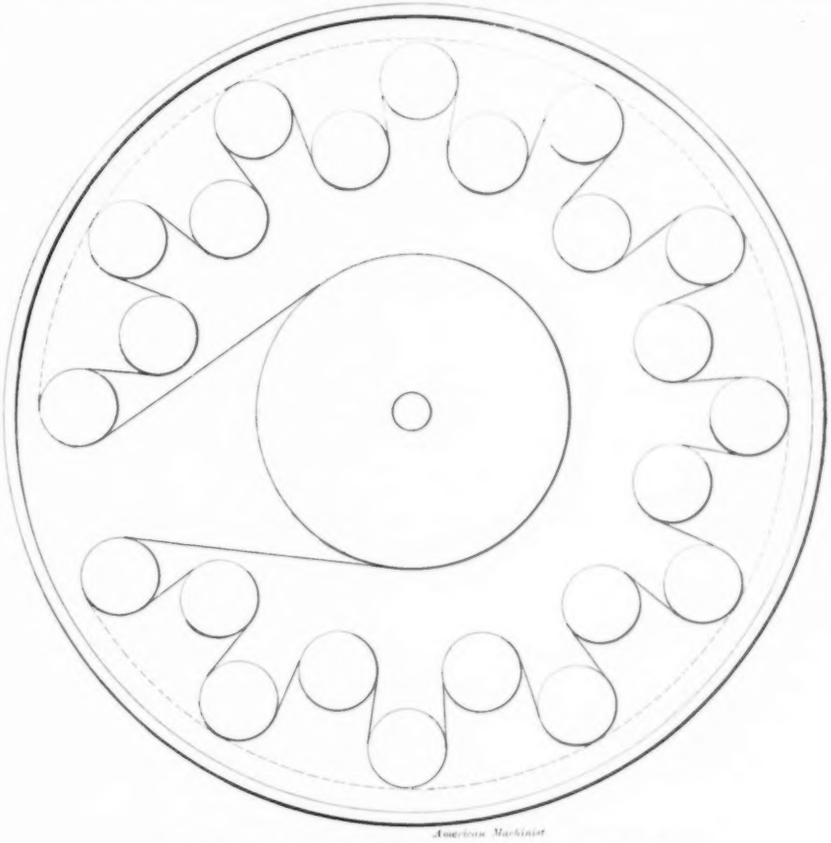
Arrangements of Gearing and Belting that Wouldn't Work.

Editor American Machinist:

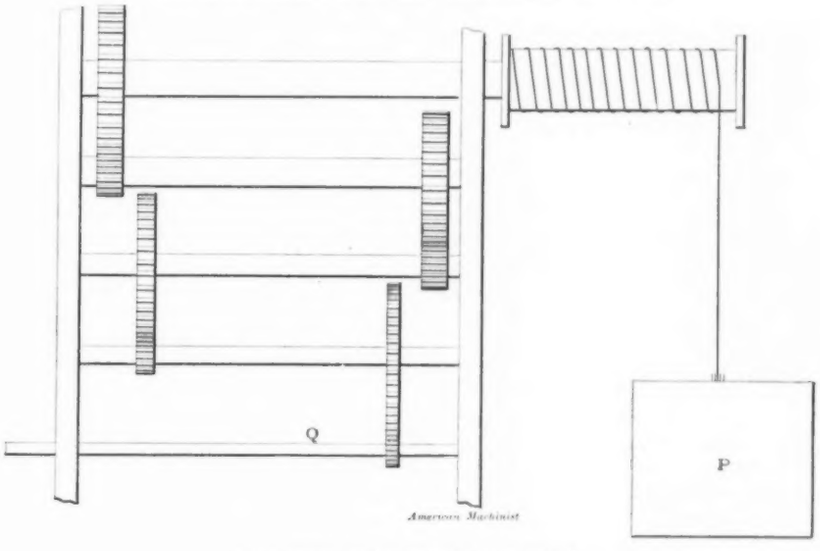
The belting arrangement described at page 1085 certainly looks efficient on paper, and might be so actually for the particular purpose for which it was designed, in which, possibly, the work to be done was slight. If the nature of the work, however, had been heavy, the work would have been extremely rough on a single belt, unless that belt were of such a width as to appear "ungainly." Lest someone might by this example be incited to follow it under less favorable conditions, I will mention a similar case, but one in which the conditions resulted in a failure to act.

The machine was a 12-spindle one for polishing patresses—circular disks of wood of an ornamental configuration. These were screwed on a wood screw let into the spindles. The arrangement of driving was as shown in Fig. 1. The outer series of circles represents the spindles, upon which are mounted grooved pulleys. These were arranged to be driven from the central pulley, also grooved, and to give a greater arc of belt contact an intermediate series of idler pulleys were fixed, one of these being adjustable radially with the center of the driver to take up slack. The spindles were to be driven by a ⅜-inch gut band threaded as shown. Advisedly I say "were to be," for an attempt even to get on the band proved a failure, although to induce a little flexibility it was "jumped upon" before the attempt; ¼ and 3-16 inch bands were then tried in turn, but until the substitution of a ⅛-inch band for these, we were unable to get a start. With much trouble this was gotten into place, and tightened up by the adjustable guide pulley. The main belt, driving to a pulley fixed on the central shaft, was shipped on. The spindles would not, however, be driven and hardly any amount of power would effect a start. We guessed there were too many bends in the band, and were induced to take out all the idler pulleys, except the adjustable one leading the band, as shown by the dotted circle. We could now drive the spindles, but when pressure was applied to the work they came to rest, the band simply slipping on the pulleys. The cure for the failure lay in replacing the single-grooved driver by one with three grooves, and driving four spindles with each of three bands and providing separate adjustments for taking up the slack.

Another case, but this time in toothed gearing. Fig. 2 shows a compound train of gears driven by a weight *P* dependent from a rope wound around a drum. Power to drive a model dynamo was to be taken off at *Q*, and of course the speed of this shaft was required to be about 4,000 revolutions per minute. I forget the exact ratio of the gears, though I think it was about 100,000 to 1, but I shall never forget the speed that was obtained. The application of a weight of 112 pounds caused the shaft to rotate just fast enough to be perceived. A man standing on the weight did not quite cause the speed to be doubled, and no additional amount of weight would give any greatly accelerated rate of rotation. Now why was this? Was it because the increase in friction due to an increased speed is proportionately greater than the speed increase? If so, it seems to me that after a certain point the further addition of weight must tend to decrease the speed. The dynamo was never driven, and the driving apparatus still remains as a memento of a failure.



MULTIPLE SPINDLE BELT DRIVE THAT WOULD NOT WORK.



GEAR DRIVE THAT WOULD NOT WORK.

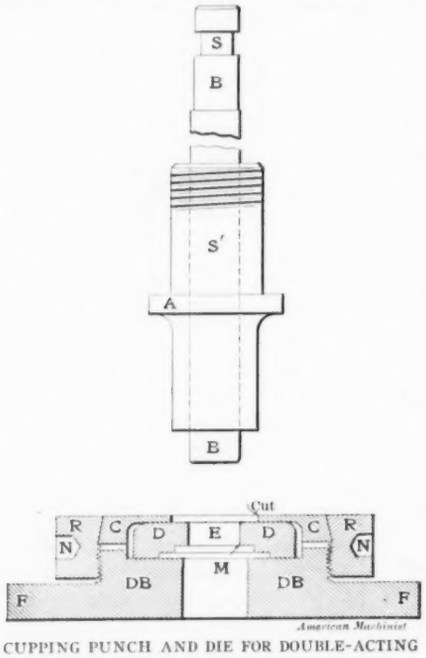
I could tell of many other cases of failure through friction of belting and gearing arrangement, as for several years I had employment in a cotton goods finishing works, where constant experimenting was the order of the day. The various contraptions in gearing I have seen would fill a book, and in most cases a description of the arrangements would serve as a deterrent from similar enterprise in the future. That element, friction, is so often overlooked, or its laws not understood, that failure may often be the reward(?) of those who attempt apparently happy arrangements to save a multiplicity of separate gearing. FRANCIS W. SHAW.

Birmingham, England.

Die-Making—Cupping Tools for a Double-Acting Automatic Cam Press.

Editor American Machinist:

It is an old saying that "comparisons are odious," but, as a rule, diemakers, in comparing methods of die construction, have a fraternal feeling toward one another, so that when an article appears in the columns of the AMERICAN MACHINIST it is always worthy of consideration, and



CUPPING PUNCH AND DIE FOR DOUBLE-ACTING AUTOMATIC PRESS.

especially to those toolmakers who are somewhat familiar with that class of work. It is not only true that steel and its uses are the studies of a lifetime, but this may also be true of punch and die making. Mr. Woodworth's article, at page 1338, was both new, novel and interesting to many of us, and, while I do not advocate some of his practice in his illustrated article, it is undoubtedly well adapted for that specified work.

About six years ago I was employed in one of those large brass goods manufacturing plants in Connecticut, and while employed there I had quite a varied experience on both single- and double-acting press tools, so I submit a description and drawing of a set of cupping tools used in connection with one of the Waterbury Farrel Foundry & Machine Company's double-acting cam presses equipped with the Bates automatic roll feed. In the sketch, *A* is the cutting or blanking punch, and *B* is the cupping or drawing punch. The blanking punch *A* has a straight shank *S'*, which is threaded at one end and is held securely in the punch holder by a threaded ring or collar.

The drawing punch *B* is secured to the "gate" of the press by a yoke key at the shoulder *S*. In making the blanking and drawing dies, we construct each one independent of the other, for the reason that the bottom or drawing die *D* has to be replaced much oftener than the top or blanking die *C*.

In this kind of double-acting press tools the punch *A* cuts the blank and holds it firmly on the top of the die *D*, and then the punch *B* descends and pushes the blank through the die *D*, and as the gate with the punches ascends the cup or cylindrical shell is stripped from the punch *B* at the edge *M*, which we commonly call the "shedder."

The bottom or drawing die *D* has a free movement sideways and therefore is self-centering, but is held down in the cast-iron die bed *D B* by the blanking die *C* being screwed upon it by the threaded ring *R*. *N N* are the holes for tightening the ring with a spanner wrench. The punch *A* is left soft for the convenience of refitting the cutting edge to the blanking die *C*. The die *D* is hardened, tempered and ground while the "draw" *E* is carefully lapped to size. The punch *B* is hardened and ground, but the temper is not drawn. The blanking die *C* is hardened and tempered and the cutting edge is internally ground (½ degree taper) to size.

It is very essential that both the blanking and drawing dies should be hardened and ground to a true and level bearing or else the shells or cups will be "crimpled." This set of tools, as described, has cut and drawn 3¼ tons of brass shells, from No. 26 metal, B. & S. gage, in three days with one setting of the tools. We cannot deny that the first cost is quite a little more than that of those describe on page 1338, but the extra cost is offset by the surprising results. MATTATUCK.

Obligations of Receivers of Catalogs.

Editor American Machinist:

I have been greatly interested in the letters which have appeared in your columns from time to time on the subject of sending catalogs to machinists or others who may make inquiries for them. The recent letter from a firm in Cincinnati copying a letter from a machinist and showing that the sending of one of their catalogs several years ago had resulted in several sales was an illustration of what is occurring every day. There is no doubt in the minds of most careful, thinking men with whom I have talked on this subject but that catalogs and other printed matter placed in the hands of machinists are a paying investment.

There are several points in regard to this question which many of the men in the shop do not have occasion to look at in the light of the men in the office. For instance, the firm with whom I am employed receive a large number of inquiries for catalogs. It is their practice to answer them all, sending a catalog and a lithograph card, and they also write a letter stating that the printed matter is being sent and asking that its receipt be acknowledged, also that they be advised as to whether the inquiry merely for the purpose of getting general information or whether the party is contemplating buying a machine. If the latter, he is requested to make known his wants and either a mail quotation will be made or a personal representative will call and see him. All of this costs money, amounting to from 15 to 20 cents for each inquiry, yet the company consider that if the inquirer is sufficiently interested to write they are justified in nine cases out of ten in going to this expense. So far it is all right.

Now every manufacturer likes to know as nearly as possible whether he has had a chance to figure on the requirements of people who make these inquiries. He therefore appreciates the favor if such persons answer his letter, acknowledging receipt of the catalog and stating whether they are in the market or not. Further, a great many companies have traveling men who cover specified territories. Perhaps such a salesman may be in the vicinity of a town from which such inquiry comes. If the manufacturer waits until he hears from the person making the inquiry, his salesman will then be in another part of the country. If the man is expecting to buy a machine, the manufacturer feels that it is to his interest to have his salesman call. If he is not in the market, such a call is useless; but, not wishing to run the risk of losing a possible sale, he telegraphs his salesman to call. If the man is in the market, the expense of the call is considered as well invested, whether a sale is made or not. If the man is not in the market, however, the expense is entirely useless. As an example, a year ago last winter, a company received an inquiry for catalog and prices. The letter had nearly all of the appearances of being an idle inquiry, yet bearing in mind the numerous complaints from machinists and others who had had no replies to their letters, and also noting that prices were asked for, they wrote to their traveling man who happened to be going in that direction the following week. He spent all day getting there, walking four miles through a country road covered with a foot of snow, and when he arrived at his destination he found only a fourteen-year-old boy, who had no intention of buying or any money to do so if he had wished to. Of course, one may say that the salesman was not asked to call. Yet

if it had happened to be a man who was really in the market and who wanted information to enable him to tell what to do, would he not have appreciated the call?

Now, in regard to the AMERICAN MACHINIST, the company with whom I am employed carries an advertisement in this paper all the time. More inquiries are received from it than from any other paper in which they advertise, yet it is seldom that they are able to trace a sale directly to this paper. And yet the management consider that it is one of the most valuable of their advertising mediums, since it enables them to put their printed matter in the hands of the "men behind the machines," the men who to-day indirectly influence sales an ' who to-morrow may do so directly.

One more thing might be said on this subject. It would be infinitely more satisfactory to the average advertiser if he received letters from machinists and others which, ir addition to asking for a catalog, would state whether the writer was thinking of buying a machine, or was merely investigating the subject, or that he was employed in a machine shop where such a machine was needed. If letters of inquiry contained such statements as these, there would be much less cause for complaint about catalogs not being sent. Most manufacturers whom I have heard express themselves on this subject state that they are just as willing to send their printed matter to the man who is merely investigating the subject with a view to informing himself, as they are to send it to a man who is actually in the market. The one thing which they do like to know is that their catalog has been received and is being appreciated.

As for myself, I have never failed to receive catalogs from manufacturers whom I have addressed, even when I stated at the outset that I was not in the market but was merely desirous of knowing something of their machine. S. A.

The Straight-Edge for the Drawing Board Again.

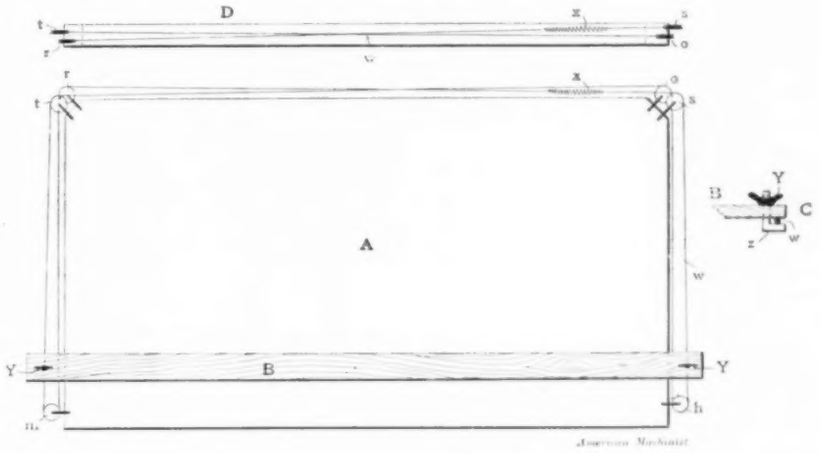
Editor American Machinist:

I herewith inclose a sketch showing the manner in which a straight-edge can be used in place of a T-square when the drawing board is of such large dimensions that a T-square is unhandy.

A is the drawing board and *B* is the straight-edge. *B* is held in position by a wire cord *w* (wire cord such as used for hanging pictures answers the purpose very well). This cord is fastened to *B* by means of two thumb-screws *Y*. The cord passes over pulleys *h*, *s*, *o*, *r*, *t*, and *m*, screwed in the drawing board as shown in the sketch. *x* is a small coil spring used for keeping the cord at the proper tension, the ends of the cord being fastened to the ends of the spring. This spring must be placed to travel along the back of the board only. *C* shows the manner of fastening the cord to the straight-edge. The cord *w* is placed between the bolt head *z* and the straight-edge *B*. Thumb-screw *Y* is then screwed down tight, thereby holding the straight-edge in place on the cord *w*. *D* shows the back edge of the board and the manner of placing the pulleys *s*, *t*, *r* and *o*.

To put the cord in place, fasten one end of it to the end of the small spring, then pass cord over *s*, then around *h*, back over *o*, then over *t*, then around *m*, back over *r*, and fasten the remaining end of cord to the free end of the spring. To fasten straight-edge *B* in place, move cord around until the spring *x* is near the pulley *s*, then place *B* as near the front of the board as the pulleys *m* and *h* will allow, and fasten to *w* by means of thumb-screws *Y*. *B* is fastened to outside cords. It will be noticed that the cord crosses at the back of the board, running from the top pulley on one side to the lower one on the other.

When using this arrangement it is necessary to keep the cord as tight as possible, without interfering with the free movement of the cord over the pulleys.



THE STRAIGHT-EDGE FOR THE DRAWING BOARD.

This arrangement is very handy in case a large drawing has to be placed back on the board after it has once been removed. Instead of making the center line on the drawing conform with the straight-edge, the straight-edge can be adjusted to conform with the center line by releasing either one, or both, of the thumb-screws and moving the straight-edge to correspond with the line.

By means of this arrangement the straight-edge can be moved by grasping it at either end or any place in between, and it will always remain true with the drawing after it has once been set.

APPRENTICE.

[The chief advantage of the arrangement shown, as compared with others which we have published, appears to be that the cords do not pass under the board, and hence the board may be used on an ordinary drawing table without interfering with the movement of the cords.—Ed.]

Taxing Patents.

Editor American Machinist:

I note at page 1332 an article, "Interesting Facts from the Patent Office," at the conclusion of which the editor advocates the imposition of a tax on sleeping patents—"old lumber," he calls them—patents in general held by people of limited means.

I think that to impose such a tax would be a grave mistake, for the inventor of the United States deserves the greatest encouragement that the government can give. What would be the condition of our world to-day were it not for the inventor? These deserving people working long and diligently on some great thought, giving their health, labor and often their very life to perfect the design, and for what reward? Too often merely that of honor. Often their last dollar goes into their work, barely scraping together enough to push the patent through the Patent Office, and the invention is doomed to sleep until the inventor can command the means to push it before the public.

Under such a law as the editor suggests, these poor inventors would lose their patents, or at least be given hardships when too often their life was full before.

If a man is brilliant enough to invent some new machine and has obtained a patent on it, he is entitled to a sole right free from all taxes for at least twenty years; for his labor, his faith and ingenuity have given him such a right.

The inventor deserves as much praise as is bestowed on any man—more than on some. We could do without the statesman, and lawyer, and many other men of affairs, but we could not have advanced as we have without the inventor.

Note that the editor says: "We believe that a series of fees to be collected at stated intervals and on which the continued validity of the patent would depend, would, by clearing away the old lumber, which is of no value to anyone, be of immense value to the industries of the country and at the same time work hardship to no one."

This intended law then is, as I understand it, to defraud the inventor of his

just rights. I cannot think the United States would think of such a thing as taxing the inventor, for all our great wealth, great industrial activity and general prosperity has been built up by the inventor's aid. Should such a law be imposed, I am in favor at once of the imposition of a similar law on all manuscripts, all statues, all work of the sculptor and all pictures that their authors have been unable to sell. Such a law is equally as just as the one proposed.

The editor speaks of "clearing away the old lumber." Old lumber means patents not in practical use, "which are of no value to anyone, would be of immense value to the industries of the country."

I will grant that these inventions would be of immense value to the industries of the country. Their inventors know it, too, but is it just to advocate such a plan to thus deprive the poor inventor of his rights simply because his means will not permit him to place the invention before the public?

Then the editor would call these patents valueless. Can he tell me what a valueless patent is? I doubt it. Few people can. I know of good patents, inventions lying in the Patent Office "sleeping" simply because the inventors are too poor to handle the inventions. Were some of these inventions pushed, the public would demand them in preference to others now manufactured, proving superior worth and advancement, as well as coining a mint of money for those who handled the articles. These inventions are sleeping, but you cannot call them worthless..

I can suggest a much better law for the utilization of these patents—"old lumber," as the editor calls them. I believe that the government should insist that all patents should be worked and put before the public at once, and pass laws to that effect, also providing that the owner should not be deprived of his just royalty.

FRANK RATTEK.

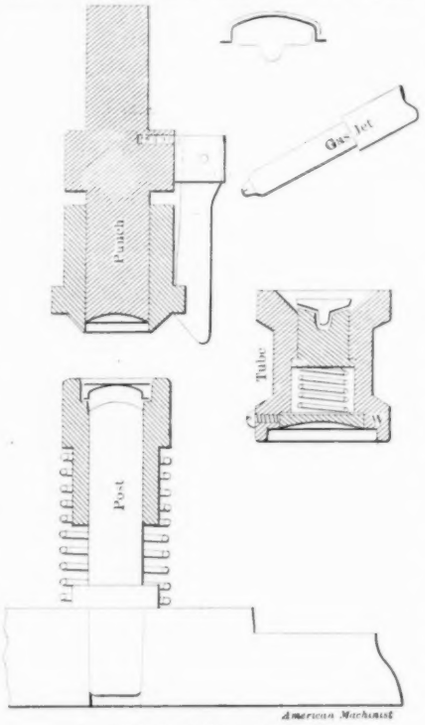
Manchester, N. H.

[Our correspondent does not note that we advocated the "imposition of a *small* fee"—say, five dollars—at the end of each five years of a patent's life. Our idea is that a patent that was not considered worth that sum by its owner should be considered as formally abandoned to the public. Such a law would work hardship to the extent of fifteen dollars on each patent—but against that must be placed the fact that the present law frequently works hardship measured by many times that amount. Some time perhaps our correspondent will make a valuable invention—complete from the whole cloth—and the search of the Patent Office will disclose a patent covering some feature of his own invention, but in such shape as to be wholly impracticable and to make the old patent commercially worthless. He will then find that his own invention has given to the old patent a value which of itself it did not have, and for having thus given value to a previously worthless invention he will have to pay roundly or permit his own to become what he calls a sleeping patent or what we call old lumber. If that time ever comes to him, he will understand that we believe in the rights of inventors who invent something that is useful and practicable, as against those who invent things that are worthless. So far as our correspondent's suggested law is concerned, where would the inventor without means find himself?—Ed.]

A Button Finishing Die and its Operation.

Editor American Machinist:

I send you herewith a button, the face of which you will find is a shell of figured metal with a lip, as shown in outline up at the right of my sketch, and with a covering of transparent celluloid. A regular



A BUTTON ASSEMBLING DIE.

button back is used inside the shell, and the shell with the lip holding the celluloid cover is closed against it. This is to describe this assembling or finishing operation.

The "die" has a post in the bed with a sleeve over it actuated by a strong spring which keeps it up in position. The shell is dropped inside this sleeve with a flat celluloid blank upon it, as shown. The punch, which when at rest stands considerably higher than here shown, descends and pushes the sleeve which it carries down far enough to allow the celluloid blank and the shell to enter it, and they are thus picked up and held for the second stroke. The gas jet keeps the upper sleeve and the punch hot enough to form the celluloid without breaking or wrinkling. The sleeve on the punch must of course be finished the thickness of the celluloid larger than the shell.

The tube shown at the right in the sketch now comes into play. It is held in the left hand of the operator, and he places in it the back of a button, as shown. It is then placed to fit over the top of the lower sleeve, and is held there until the punch descends. The hook which holds the upper sleeve in position is pushed aside and the sleeve comes up against the shoulder on the punch. The lip on the shell comes between the interior curve of the tube and the top sleeve, throwing it down and against the celluloid cover, and they are pressed together against the back of the button. In this last stroke the hand-held tube is pushed down until the washer *W* rests solid on the post, thus giving a firm closing pressure. The back of the button fitting loosely in the shell enables it to enter before the closing occurs. It rests on a sliding central plug, which is held up by a light spring resting upon the washer, thus allowing it to back down during the closing operation. As the punch ascends, the completed button is removed, and the sleeve is automatically hooked in place again for the next button, and so on.

H. HORNICK.

Bracing Up a Shop.

Editor American Machinist:

When four or five of our friends had given their views and my toolroom was finished I thought it time to send in a reply, which I did. Now comes Mr. Danse at page 1376 with what he supposes to be an analogous case and relates how he transformed chaos into order. I have not seen the shop to which Mr. Danse refers either before or after this "transfiguration," but I will state that if he got all his men so that they would put everything, including small things like gage-size drills and taps, *just* where they belonged he made angels out of mortal men and accomplished more than any man I ever heard of. I, for one, cannot believe that. It probably is some years since Mr. Danse had the experiences and these small but aggravating details have undoubtedly skipped his memory.

At the time of making my inquiry, our shop was cleaner and more orderly and the men, as a whole, at least as well behaved as in any other shop in the city. We had no scrap heap except where it belonged, no handleless sledges or monkey-wrenches (and none with pipe handles, either). We *did* have racks for steel and iron, bins for castings, racks and bins for finished parts. Each man was furnished with an individual dish of warm water at quitting time, clean places were provided to hang clothing, ice kept the drinking water cool in summer, the closets were washed and disinfected twice a week; in short, there are few shops to-day, even among the larger ones, where things in general are better taken care of than in ours at that time. Neither were the men at all handicapped by the firm's neglect to furnish that which was necessary to do the work with.

As to my treating the men properly, I have little to say. Drunkards and "sporty" men do not work for us—not when we know it. We never curse a man nor give him "hell," and not long since a man was discharged for cursing one of his fellow-workmen. Reprimands are administered when necessary, and incurables are promptly discharged; but if we were bound to have men that always put everything back in its place, we'd have to either go out of business or get some of the men Mr. Danse had in his model shop.

As to my personal example in orderliness, I will say only this: While sitting here at my desk at home I think I could lay out a diagram of the twenty-seven pigeonholes and twelve drawers in my desk at the shop and tell very closely what each one contains. Little more needs be said; 'tis true the men do not call me "Mr. Dutch," but I lose no sleep over that. One thing I will say: I have met men in charge of some of the best machine shops in the country and I do not know of a single one who would undertake to *make men orderly*, but they all depend on their toolrooms and check systems to enforce the returning of tools to where they belong, and in many cases it has in addition been found necessary to charge the men for tools lost to check their disappearance.

I do not doubt Mr. Danse's good intentions in citing his case, but I do not see any analogy to our condition at the time I made the inquiry; the shop he describes was like the proverbial bad egg—it could not be spoiled—and little could have been done that would not have been an improvement, whereas in our shop it was a question of eliminating or reducing the objectionable features still left.

DUTCH.

A Circle to Enclose a Given Number of Smaller Circles.

Editor American Machinist:

Referring to the submitted inquiry of Mr. Rogers, at page 1314, for a formula or process for finding the diameter of the smallest circle that will just enclose a given number of equal tangent circles; or the converse, how many small circles of given diameter can be contained in a larger circle of given diameter, permit me to offer the accompanying solution:

Take the converse first and suppose, as suggested by Mr. Rogers, that it is desired to know how many ¼-inch round wires a 4-inch pipe will hold. Lay out a section of the 4-inch pipe by describing a circle with 2-inch radius, and draw the horizontal center line. Divide this line into as many equal parts as the diameter of the wire is contained times in the diameter of the pipe—that is, $4 \div \frac{1}{4} = 16$—beginning at a point whose distance from the circumference equals one-half the diameter of the wire. Through these points of division draw two sets of lines at 60 degrees with the horizontal, and, about each point of intersection of these lines as a center, describe a circle with ⅛ inch radius, thus representing sections of the ¼-inch wire, as in Fig. 1.

The 60-degree lines form the sides of equilateral triangles whose bases are ¼ inch, and each angle of the triangle is the center of a ¼-inch circle, consequently the circumferences of the circles are in contact, but do not overlap, thus affording a perfectly compact arrangement of circles or wires, as shown to larger scale in Fig. 2. Thus arranged, the 4-inch pipe will hold 208 ¼-inch wires. Assuming the wires to be perfectly round, no other arrangement of the wires or position of the pipe relative to the wires will afford room for another one.

To prove that the pipe will not contain more than 208 wires if the wires were arranged in concentric circles within the pipe, I append the following solution of the

FIG. 1

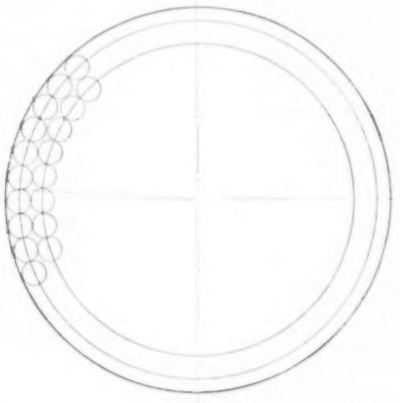


FIG. 3

FIG. 2

FIG. 4

A CIRCLE TO ENCLOSE A GIVEN NUMBER OF SMALLER CIRCLES.

solution of Mr. Rogers's question, as the author assumes the diameter of the outer circle to be an exact multiple of that of the smaller circles, which it would not usually be. We do not think the general problem is capable of solution, though this partial solution may at least serve as a guide.—Ed.]

The Length of the Work-Day.

Editor American Machinist:

Your editorial on "The Length of the Work-Day" is very much to the point, but it fails to throw light upon the cause of the prevailing agitation to force a shorter work-day by legislation.

In the industrial world the fact can be observed that on the whole the supply of labor exceeds the demand. There are more workmen than there are jobs. This is especially noticeable during periods of so called industrial depression, but even during prosperous times ample evidence of this condition can be observed. Considering that workmen will not work for nothing, but expect wages in return which they will expend on necessaries of life, it is obvious that the supply of labor is invariably associated with an equivalent demand for labor's products, at least indirectly. The fact that there is not enough work to go around, therefore, constitutes a paradox. There can be but one rational explanation. In our present system of production and exchange there is a factor at work which, in a measure, limits the amount of work that can be done within a given time, and this amount is less than that which the workmen are willing to perform in their efforts to obtain a maximum of comforts. Assuming this to be so, it is evident that if this work were uniformly divided among all

number contained with the wires thus arranged. Referring to Fig. 3, the radius of the circle through the centers of the extreme circle of wires is $2 - \frac{1}{8} = 1\frac{7}{8}$ inches = the hypothenuse of a right-angled triangle whose perpendicular is ⅛ inch. Referring to Fig. 4:

$$\sin.^{-1}\ \frac{1}{1\ \frac{7}{8}} = \sin.^{-1} .0666 = 3^\circ\ 50.'$$

$$3^\circ\ 50' \times 2 = 7^\circ\ 40.'$$

= the angle subtending the arc whose chord is the diameter of one wire.

$$360^\circ \div 7^\circ\ 40' = 47 \text{ nearly,}$$

equal the number of wires in the extreme circle. By the same method, the remaining circles will contain respectively 41 wires, 34 wires, 28 wires, 22 wires, 12 wires 8 wires and 1 wire, making a total of 193 wires—15 less than in the previous arrangement.

WESTERNER.

[We do not regard this as a complete

workmen, each would obtain a limited share; and if anyone should succeed in performing more than his share, he would deprive someone else of his opportunity to find work. This would explain the grinding effect of competition and justify the attempts of labor unions to more uniformly share the work by a compulsory restriction of the time of labor. But would it not be better to try to discover the cause of the existing artificial obstruction to production and remove it?

Philadelphia. HUGO BILGRAM.

[Certainly, if there is such an artificial obstruction—if labor wanting opportunities to work and capital seeking opportunities for profitable employment are prevented from joining forces for the production of wealth by an obstacle which can be discovered and removed, no more useful thing can possibly be imagined than to discover and remove it. But there are many who think they have identified the obstacles and many are trying to remove them (for they do not agree as to what the obstacle is), and all that we can do is to suggest serious thought and study upon the subject. It will be far more effective than all the strife or fighting that can possibly be indulged in.—Ed.]

The Draftsman and His Work.

Editor American Machinist:

Draftsmen form one of the most important factors in the industrial arts and manufactures. They are the designers, inventors and originators of all kinds of appliances, machinery, tools and structures. To the public in general a draftsman is an unknown quantity. If he says he is an engineer, which every draftsman who does any designing is, more or less, most people think he is an engine driver. If he says he is a designer of machinery, they think he is a machinist. Most mechanics know of the draftsmen as makers of drawings, or, perhaps, better as makers of mistakes on drawings.

The drawing is generally accepted much like a newspaper; it is a useful article, but nobody cares anything about who made it. No machine work of any importance can be acomplished without the aid of drawings giving full particulars of how the thing is to be made, all dimensions, material to be used, etc. In short, a drawing takes the place of all kinds of written and oral orders and instructions, and is therefore one of the greatest time-saving devices employed in construction work, whether it be machinery, buildings, bridges, railroads, ships, canals, etc. Thus the drawing takes the place of the draftsman himself and no thought is given to the maker of the drawing, unless some trouble should arise, when the draftsman is called to help, or unless an error in the drawing is discovered, when a great howl is raised.

The worry, vexations, disappointments and patience it has cost to produce the drawing, nobody but the draftsman himself knows. In many cases troubles arise in the shop or field from not strictly following the instructions and dimensions on the drawings. Usually working drawings are prepared with much care and precision, so that the different parts, if the subject is a complicated machine, for instance, shall fit together exactly. But if any deviation from the drawing is made in one part without following up the effect of this on other parts, there naturally will be trouble, and in such cases, when the real cause is not discovered the blame is often put on the drawings.

This practice of deviating from drawings is an abuse which should never be tolerated, but which, however, is carried on to a great extent in large establishments without any record being kept or the drawings changed. Particularly annoying is this when any new work or addition has to be made in an old plant. When old drawings, showing the work as it was intended to be, but not as it actually was, made, are used as a guide for fitting new work into the old, there will surely be trouble, and again the blame is put on the unsuspecting draftsman. Sometimes it may be found necessary to make things different from what the drawings show, but more often such deviations are made either from carelessness, neglect, inability to interpret the working drawings or a simple desire to make changes. This would not happen if the draftsmen were allowed to inspect the work. The man who has designed the work certainly is the most competent one to make the supervision and inspection. Many drawing rooms have a practice of marking the shop drawings with the works:

Stick to figures!
Make no changes!
Report errors!

If these instructions were strictly followed much annoyance and trouble and loss of time later would be avoided.

It has already been pointed out that the draftsman receives little credit for his work. He is often not even told of the successful working of his design. Usually somebody else claims the credit. But on the other hand, if there is a hitch in starting new machinery, many wise heads and some fools will come forward and say: "I told you so," or, with a supercilious air, tell you how it ought to have been, although they had the drawings in hand and had ample opportunity to criticise the design before the work was built.

I have said that the draftsmen are originators. Being employed to perform the work assigned to them by their superiors, they have to work out and perfect ideas originated by somebody else. But it is two quite different things to have an idea and to make it practicable. The draftsman is accustomed to deal with abstract things and is often able to say at once if a proposition is practicable or not, but still he has to make detailed designs in order to convince his superiors, who will not easily drop their ideas of impossibilities.

Few men employed in the technical pursuits are required to know so many different things, both practical and scientific. In order to design machinery of all kinds and structures, he must be well versed in mathematics, chemistry, mechanics, electricity and other branches of physics, and also have a practical knowledge of the different trades, as patternmaking, molding, forging, pipe-fitting, machine-shop work, carpentry, bricklaying, etc., so that he knows how things are done and what can be done. He must also possess good judgment in making drawings plain and intelligible to others, not omitting any necessary information, nor being too elaborate. When a new design is to be made the draftsman starts with a clean paper, his tools and a vague conception of something that shall perform certain work, and be restricted within certain limits as to space, expense of construction, cost of operation and also conform to certain requirements as to strength and durability, materials, accessibility, appearance, etc. To do this he very often has to depend solely on his own experience, knowledge and judgment. As the ideas are evolved in his mind they are put down on paper to scale. Much care, thought and patience are required to do this. After much time has been spent trying to perfect some part, it is found to interfere with the proper working of some other part and has to be redrawn over and over again.

There is probably no work more wearying and nerve exhausting than the scheming and devising a draftsman has to do, and this is especially hard when the time allowance is short. When the drawings are finished in detail they are submitted for approval by the powers that be, perhaps the works manager or the purchaser, or both, and in most cases they will come back marked with changes desired to suit their ideas, or perhaps some pattern being on hand must be used, in order to save the expense of making a new one, and other parts have to be changed to suit this, or perhaps the expense involved in building the work will be too great. The draftsman must then go through the same brain-racking performance again. Sometimes the work is not built at all, and the draftsman's work and anxiety of months are in vain. Of course he is paid for this, but every designer takes some pride in seeing the result of his labor. Taken as a part of the manufacturing process, machine design is expensive, the cost of one single drawing often amounting to many hundred dollars; but carefully worked out drawings will repay expenses many times by the great saving in material and labor effected by a skilled designer.

To many people designing and the making of drawings seem identical, and complaints are often made over the expense and slowness of the drawing-room. The draftsman is often expected to improve,

perfect and devise machinery and consume no more time than when making the drawings of some old and familiar article. No time is allowed for thinking, studying or calculating. This is the greatest annoyance the draftsman has to contend with, because it shows him, more than anything else, how little his art is appreciated, but at the same time it shows great ignorance or unreasonableness on the part of his employer.

We often hear talk about "tramp machinists," but draftsmen are nearly all tramps. When the draftsman has finished the designs required in one place, his usefulness there is at an end and he has to look for another job. Or perhaps his feelings are hurt or he gets sick of the work and throws up the job. At any rate he seldom stays many years in one place. At one time he may be engaged in steam-engine work, at another on bridge and structural steel design, or electric machinery, or cranes, or pumping, printing, laundry machinery, etc., *ad infinitum*, or he may work on cotton mill machinery (he'll get wheels in his head then), or he may have to design a flying machine.

A certain freemasonry exists among draftsmen. From the Atlantic to the Pacific coast they know of one another, even if they have never met, some leaving their initials on drawings, some being recognized by their particular style of lettering drawings. Few draftsmen marry. To move from place to place with family and household goods is a great expense, and probably this is what deters most draftsmen from any matrimonial venture. What becomes of draftsmen when they are old is a mystery. Perhaps they don't live long. Certainly draftsmen beyond middle life are rare.

Of draftsmen there are many varieties. There is the "bluff," who travels all over the country and everywhere impresses people as being a genius, until he commits some costly blunder. Then there is the "hustler," whose only aim seems to be to manufacture drawings as fast as possible. To some people he may seem a valuable or what they call "a good man." If there is a careful checker to examine his work, good and well, but it will invariably be found that many dimensions that should be given are left out, because it would take some little trouble to ascertain them. Then, again, there is the careful man, who spends some time looking out through the window, thinking, and endeavors to produce the best possible design, without regard to time spent. Some unappreciative people may think he is slow, but he is really the most valuable one of all.

The wages paid to draftsmen vary in different localities, the best men being always underpaid. In some places the pay is by the hour or by the day, in some by the week, perhaps in most by the month. It is easy for any draftsman to get $90 per month, and $100 per month is a common salary. What are called first-class men receive up to $125 or perhaps $150 per month. The former figure is probably the limit, except in the case of chief draftsmen, when this figure may be doubled, but the chief may kill himself by overwork. The difference between $90 and $100 is very small, but very often the man who receives the latter figure is five times as skilled, has considerably more experience, is twice as old and much more valuable to his employers than the one who receives only $10 per month less. So it is seen that the compensation paid is not in proportion to services rendered.

For a young engineer just from college, there is probably no better place to acquire a general experience in engineering than in a drafting room. But I would advise him not to stay too long. If he does, he may get into a rut and not be able to get out of it and may become a "tramp." KABE.

[Most people think the hardships of their own occupation are greater than those of others, but who shall say that there is not a good deal of truth in our contributor's lament?—Ed.]

A Long Spring Mandrel — Compressed Air for Jig Clamps.

Editor American Machinist:

A mandrel 3-16 inch in diameter and 120 feet long is unusual, yet that is just what I saw recently at the Boyer plant of the Chicago Pneumatic Tool Company, spinning away merrily at the rate of several thousand revolutions per minute.

This mandrel is used for coiling the piano wire closed springs which are used instead of belts to drive the Boyer speed recorder, and it is rotated by means of an air drill at one end, while the other end runs in a bearing attached to a post. An ordinary wooden clamp, faced with hard fiber, held in the operator's hands, governs the feed of the piano wire and hence the closeness of the coil; and, to the lover of physics, not the least interesting feature of the operation is the manner in which the long, thin mandrel is thrown into loops and nodes during its rapid rotation.

I had never before seen a helical spring even remotely approaching such a length, and probably most of your readers have not seen anything of the kind either. The simplicity of the arrangement for doing the work is admirable. The operator informed me that the lot of wire being operated on weighed 4,004 pounds, which is quite a respectable amount of 3-16 inch spring.

I was informed that it has been found impossible to secure wire of sufficiently uniform temper for this work from any American maker, and that none but imported wire is used. This strikes me as rather curious, as, during my travels abroad, I learned that it was quite impossible to secure nail wire sufficiently uniform in temper or true enough to gage to work satisfactorily in "two-wire" nail machines, anywhere except in the United States. Of course, in the one case, a hard wire is wanted, while in the other it is a soft wire; but, since hardness and softness are governed by well-known rules of chemistry and manipulation, there seems to be no good reason why either American or European makers should fail to produce exactly what their customers demand.

This reminds me that a well-known Birmingham manufacturer told me that English iron was not good enough to use in a screw-thread rolling machine, and in support of this statement showed me a stud which had split up into a regular broom when he tried to roll a thread on it. I know of at least one American manufacturer who was successful in rolling threads on American iron bolts, and probably he is not the only one. However, iron is such a rare material now that it matters but little whether it can be commercially produced of good enough quality for rolling threads.

The 3-16 inch mandrel reminds me of an instance in which "knowing how" recently enabled me to get around a difficulty. One of our drill jigs was a sort of two-story affair, the upper portion being slipped down over the work and guided into position by two 3-16 inch dowels which entered bushings in the mating half of the jig. The man who made the jig had drilled the hole for the bushing about half an inch deeper than the bushing, and then made too loose a fit of the bushing in the hole, so that after being used a short time the bushing had been pushed back too far in the hole to admit of the dowel entering it. Drilling from the other side and driving the bushing back was not practicable, and it was proposed to make a double hook with a wedge in it that could be driven into the bushing and expanded so as to pull out the bushing. Of course, this would have been quite expensive, and I suggested taking a piece of 3-16 inch drill rod and drilling a 1-16 inch hole through it, quite close to the end, slipping a bit of 1-16 inch drill rod 3-16 inch long into the hole and then shoving the 3-16 inch rod through the bushing till the 1-16 inch rod dropped partly out, and formed a hook behind the bushing. Catching the 3-16 inch rod in a vise, a few taps on the jig with a lead hammer soon brought out the offending bushing, and before it was replaced a piece of drill rod was put into the hole in the jig, so as to prevent the bushing from again going in too far.

But I am forgetting to tell you about the things I saw at the Boyer plant, and it would not be fair to your readers to omit mention of some drill jigs in which the clamping of the work was done by means of compressed air acting on pistons connected to the clamps, instead of by the usual screws, keys or cams. This method is instantaneous in action and just as positive with a careless operator as with the most careful. Its principal advantage is realized when the necessary movement of the clamp is of considerable length.

Detroit. L. O. DANSE.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,400 copies are printed. Total for 1902, so far, 791,800 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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An Example of a Real Monopoly.

Everybody is rejoicing over the settlement of the coal strike and hoping, though perhaps with little ground for the hope, that we shall never experience another such contest over what is a vital necessity of modern life and industry. All who have cared to read articles on the merits of the contest or about the relative merits and demerits of the two organizations that have been carrying it on have found plenty of such articles, and we do not propose to add to the number; but it is to be hoped that manufacturers generally will not fail to note the very plain showing that has been made of the essential difference between a competitive business and one that is a real monopoly. All of the active and intense interest of the public in the anthracite coal strike springs from the fact that there is an effective and close monopoly of the anthracite coal business.

It is a matter of common knowledge, and so far as we know not disputed, that many years ago the anthracite coal carrying roads by concerted action raised the rates for transporting coal to the market to a figure above that charged for carrying first-class perishable freight over the same roads. This was done, not solely "because they needed the money," but for the further object of so depressing the value of mining properties that they could buy them in at their own price. In the matter of supplying cars for the shipment of coal, too, and in various other ways, they violated their duties, if not their legal obligations, as common carriers in order that by thus ruining, or partially ruining, the business of the independent producers they could buy up the coal mines and lands at their own prices. They were successful in this and now control about 90 per cent. of the anthracite lands and mines, only a few of the very strongest independent operators, such as the Coxe Bros., being able to stand up against them and fight the matter out in the courts and elsewhere.

Having now gotten things entirely into their own hands, the officers of this union meet once a year or at stated intervals in the Central Building on Liberty street, this city, and, seated around a table, decide how much coal shall be mined during the ensuing year and how many tons each of the roads composing the union shall be allowed to carry to market. They have penalties for exceeding this amount and have been known to inflict these penalties. In other words, they have for years done precisely the same thing as is done by the workmen's unions when they attempt to restrict the amount of work that shall be done by a man or upon a given machine for a day's work and by that means kept the price of coal to the consumer much above what free and open competition would allow it to go. They thus produce and constantly maintain a partial famine of anthracite coal, regardless of the rights of manufacturers who must use it or of any other rights except their own.

A mining plant and a railroad connecting with it and by which its product must be shipped to market, may properly be considered a machine for the production of coal. Does the mine operators' union allow these machines to be used to their full capacity? By no means; they closely restrict the output of these machines, for the purpose, as they say, of "preventing the demoralization of the coal business." Prevention of demoralization means choking off of all competition and keeping prices at an artificially high level—that and nothing else.

As we have before pointed out, any manufacturing business, even though it be very large, must operate under actual or potential competition unless it possesses some monopoly of materials or of lines of transportation, which very few of them do possess. In other words, even where there has been a combination taking in the majority, or even all, of the establishments in a given line, the business must yet be conducted in full recognition of the fact that there is plenty of capital and plenty of brains ready to be engaged in the same business and which will be engaged in it as soon as it is clear that prices or other conditions are such that a fair return is promised. This thing has happened over and over again, and is even now happening in the machine business. But this thing cannot happen in the case of the anthracite coal monopoly because capital and labor which would naturally seek employment in the business find the coal lands and the coal carrying roads closely monopolized so that there is no possibility of free competition in that business. Just here is the difference which we have been trying to make plain between a mere large aggregation of capital, or a so-called trust, and a real monopoly.

In the case of the anthracite trade there is a monopoly of both materials and lines of transportation and we urge that manufacturers, most of whom we know do carry on business under strictly competitive conditions, refuse to be classed with such monopolies, and particularly that they decline to defend them under the mistaken assumption that they have interests in common. All monopolies may be said to have reason for making common cause against the rest of mankind, but the manufacturer engaged in competitive business is injured in every way by monopolies such as the anthracite combination has been shown to be. Fifteen years ago the AMERICAN MACHINIST, in words penned by an editor now dead but whose work still lives, said that this anthracite monopoly was a monstrous thing which the people would some day be obliged to break up, and expressed the hope that the then new Interstate Commerce Law would be effective against it. The monopoly has nullified that law and some other means of dealing with the situation must be found.

The Cleveland Convention of the National Machine Tool Builders' Association.

The convention of this association assembled at the Hollenden Hotel, October 14. The objects of the association are, of course, chiefly commercial, and the actions taken, with one exception, related to the securing of more uniform practice in the matter of extras, electrical drives, terms of payment, etc.

The exception referred to was the adoption of a resolution on the metric system, which was preceded by an address on that subject of F. A. Halsey. Mr. Halsey stated that his appearance was, in a measure, unbecoming, because it anticipated a paper which he has in preparation for the December meeting of the American Society of Mechanical Engineers, but that the importance of the subject at the present time had caused him to disregard such considerations.

In his remarks he pointed out that while the list of names now registered in favor of the adoption of the metric system by this country is imposing, the list of facts submitted by the owners of those names is quite otherwise. He dwelt at some length upon the misrepresentations of the metric advocates in claiming the famous report of John Quincy Adams to be favorable to the system and read several extracts from that report. He gave instances of the persistence of old units in France and Germany, claimed that those countries are still in the transition period, and characterized the assertion made by the metric advocates, that we can make the change in from three to five years, as "ridiculous rubbish." He devoted a good deal of attention to the suggestion that existing standards be preserved by the use of metric equivalents for inch dimensions, claimed that this was impossible, that such standards could be preserved only by preserving the inch, that the adoption of the metric system to the extent of retiring the inch involved the abandonment of existing standards, and claimed to show by quotations from the metric advocates that this is what they, in fact, expect.

Mr. Geier, of the Cincinnati Milling Machine Company, followed with a paper giving a detailed estimate which that company had made of the cost of new equipment of small tools necessary for changing their product to the metric system, the figures being altogether astonishing.

The convention then condemned the bill now before Congress in the following resolution:

"The members of the National Machine Tool Builders' Association in convention assembled, having carefully considered the provisions of House bill H. R. 2054, do hereby emphatically protest against the enactment of said bill, because:

"First—The experience of Germany, in which the old measures are still in large use, has shown that the change cannot be completed even after a generation of confusion.

"Second—The sale of many million dollars' worth of machine tools has been made abroad by members of this association, especially to France and Germany, without requirement or request, by the purchasers, for changes in general construction to conform to metric measurements, the only changes being in adjusting and measuring screws, the great majority of machines needing no changes whatever.

"Third—The adoption of the metric system would entail an enormous first cost of new equipment to conform to the new standards, and a constant increased cost in the maintenance of a double standard for repairs and renewals, and a consequent increased cost of the product to the consumer."

We are not informed of the vote, but the sentiment of the members appeared to be substantially unanimous.

The following officers were elected for the ensuing year: President, Joseph Flather, Flather & Co., Incorporated, Nashua, N. H.; first vice-president, William Lodge, Lodge & Shipley Machine Tool Company, Cincinnati, Ohio; second vice-president, W. P. Davis, Davis Machine Company, Rochester, N. Y.; treasurer, Enoch Earle, P. Blaisdell & Co., Worcester, Mass.; secretary, P. E. Montanus, Springfield Machine Tool Company, Springfield, Ohio.

Machine Designer.

The United States Civil Service Commission announces that on December 9-10, 1902, an examination will be held at Philadelphia, Pa., for the position of machine designer.

Applicants must have had not less than three years' experience as machine designers in first-class machine shops or repair shops. Certificates of graduation from recognize technical schools, embracing a course in machine tools and shop work, or three years' experience as first-class machinists will be accepted as equivalent to one of the required three years' experience as machine designer.

From the eligibles resulting from this examination it is expected that certification will be made to the position of machine designer in the United States Mint at Philadelphia, Pa., at a salary of $4.50 per diem, and to other similar vacancies as they may occur.

Persons desiring to compete should at once apply to the United States Civil Service Commission, Washington, D. C.

Draftsman.

The United States Civil Service Commission announces that on December 9-10, 1902, an examination will be held for the position of draftsman in the Engineering Department at large in New York.

From the eligibles resulting from this examination it is expected that certification will be made to the position of draftsman (male), Engineer Department at large, New York, at a salary of $1,400 per annum, and to other similar vacancies as they may occur.

Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C.

A Patented Process for Hardening Metals.

Mary J. R. Greenman, of Wilkesbarre, Pa., has recently obtained a United States patent for an alleged process for hardening metals, "precious metals, copper or iron." The following is from the specification of the patent:

"The ingredients employed for carrying out the process are charcoal, bone-dust, sulfur, sal-ammoniac, sugar, salt, magnesia, borax, potash, arsenic, sweet spirits of niter and sulfuric acid.

"The method of employing the process is as follows: Prior to adding the niter and sulfuric acid all of the solid ingredients above set forth are pulverized and thoroughly mixed or commingled. These ingredients are then placed in a retort, and the copper or other metal to be hardened is embedded in these ingredients within the retort, so as to be entirely covered by the same. Spirits of niter diluted with about equal parts of water is poured upon the mass, so as to moisten the same, and then sulfuric acid diluted with about equal parts of water is poured on. The vessel or retort is then closed and heat slowly applied, the same being increased gradually.

"At the end of about five or six hours the mixture will be found to have been fused into a gray slag and the carbon of the ingredients to have become absorbed in the metal, and the hardness of the metal will be found to have greatly increased. This process is particularly applicable to pure metals without alloy.

"For the purpose of tempering cutlery-steel I employ the hereinabove-mentioned ingredients with the exception of the charcoal and bone-dust. To the ingredients used I add about 5 gallons of distilled water, which dissolves all of such ingredients with the exception of the sulfur and magnesia, which, being insoluble in water, settle to the bottom of the receptacle in the form of a sediment. The steel is heated to a cherry red and plunged into this bath, and when drawn out it will be found to be hardened. Then the temper is drawn to the depth of the edge required and the metal ground and polished.

"The ingredients above set forth are mixed in about the following proportions: 4 quarts charcoal, 1 quart bone-dust, 3 ounces sulfur, 3 ounces sal-ammoniac, 3 ounces sugar, 3 ounces salt, 3 ounces magnesia, 3 ounces borax, 3 ounces potash, 3 ounces arsenic, 6 fluid ounces sweet spirits of niter, 6 fluid ounces sulfuric acid."

Crushed Steel and Steel Emery.*

This artificial abrasive was known in a primitive way a good many years ago. The Germans were the first to make use of it. In extreme cases in the industries, where a cutting material harder than the known abrasives, such as emery and corundum, was required, the Germans resorted to breaking up old files. This of course was done in a primitive and uncertain way, and was confined chiefly to experiments in the laboratory.

My attention was first called to the article by the patentee, Mr. C. M. Lindsey, who, being in the marble and stone-cutting business, and in need of a hard abrasive, conceived the idea of breaking up hard files as a medium for cutting. His efforts in a commercial way were, however, unsuccessful, from the fact that there was no known means of making a uniform product, and the difficulty of breaking the files made it impossible to obtain satisfactory results from this method.

I became interested, and concluded that if methods could be had by which a uniform granular structure could be produced, it would prove effective, and that the field would be large in which it would have superior advantages over any of the known cutting materials. After a vast amount of experimental work and a great many unsuccessful results, the proper methods were found to produce the article in absolutely uniform grains and structure and sizes, of a resulting hardness or toughness as might be required, and at a cost of production which permitted it to be put in successful competition with the competitive natural and other artificial abrasives. This investigation resulted in the formation of the Pittsburg Crushed Steel Company, Ltd., of Pittsburg, Pa., U. S. A., in the year 1889.

The products are used to-day quite extensively in all the known arts and industries, both at home and abroad, where an abrasive material is required. It is manufactured preferably from pieces of high-grade crucible steel, heated to a temperature of about 2,500 degrees Fahr. (almost a white heat) and then quenched in a bath of cold water, or other suitable hardening solution, which gives the steel a granular structure. The pieces are then placed under powerful hammers or crushing machines, and reduced to small particles, varying from fine powder to grains of various sizes. The steel particles are then tempered, preferably in the following way: They are placed in a cylinder or pan and heated to a temperature of about 450 degrees Fahr. until the particles change their appearance to a straw color; they are then cooled by being exposed to cold air in various ways. The material at this stage, or before the tempering process, is graded into many sizes, according to the number of mesh openings per square inch of the screen or sieve.

The sizes of diamond crushed steel run in numbers from 6 to 60, inclusive. Diamond steel emery is similar to crushed steel, but is given an intensely hard temper, and its numbers range from 60 to 200 and above. Diamond crushed steel is generally tempered to a tough hardness, while diamond steel emery, having different work to perform, is made intensely hard. A grain of crushed steel examined under a magnifying glass, exhibits a series of sharp points and cutting angles. In the abrasive process, as fast as one point is worn down another is presented, while, should a grain break, it presents on the fractured face a multitude of new cutting points. When a grain breaks while in use, it simply becomes two grains. In this respect a grain of crushed steel is unlike all other abrasives, the life being phenomenal; and the grain or grains must be worn away to an infinitesimal atom before losing their cutting power. All other abrasives break down to a powder, and in a very short time become inert and useless.

Crushed steel and steel emery are now used in the sawing, rubbing and polishing of stone, marble, granite, onyx, etc,. in lens grinding, glass beveling, brick grinding, and by lithographers, engineers and plate-glass manufacturers. If a bond could be found, so that these steel abrasives could be placed on the market in the form of a wheel or brick, the length of the above list would be much extended.

Lack of acquaintance with diamond steel emery may lead the workman to believe that it has ceased to cut long before its power is exhausted. This is due to the absence of the peculiar grating sound produced in the usual grinding operation. This is caused by the minute particles of the abraded metal, which thicken the oil and so prevent the diamond steel emery doing its work promptly. The addition of a little oil permits the grains of steel to again move freely and new life has been given to it. In ordinary grinding, and on flat surfaces, diamond steel emery is used in precisely the same manner as ordinary emery, but special care must be exercised in its use on account of the grains of steel emery being so much smaller than the abrasive heretofore used for the same purpose. Oil must be applied sparingly to prevent the steel emery being drawn out and floated away. On curved surfaces or where there is a double seat, one above the other, it frequently happens that a lateral "dishing" or swinging movement cannot be given. Where such surfaces are to be ground, the work should be frequently lifted, so as to prevent grooving.

Some years ago the Pittsburg Crushed Steel Company demonstrated the remarkable efficiency of diamond crushed steel and steel emery by cutting two large meteorites, furnished by Prof. Henry A. Ward, of Rochester, N. Y. The operation was watched by a number of scientific gentlemen, who expressed their surprise and astonishment at the remarkable speed at which these meteorites were cut. To show the rapid progress made by this method it is only necessary to say that 13 inches have been cut in 57 hours in this hitherto practically invincible material. One of the meteorites weighed 320 pounds, and was sawed in a horizontal saw frame, using eight wrought-iron blades 4 inches wide by 3-16 inch thick and 8 feet long, and set about 2 inches apart. The second meteorite was cut with twelve blades under the same conditions, but was considerably larger and weighed about 650 pounds.

To manufacture diamond crushed steel and steel emery has required years of patient toil in bringing about proper results, and the machinery employed in the manufacture is the result of much labor and experiment.

* From a paper by M. M. Kann before section D of the American Association for the Advancement of Science.

Technical Publications.

"Hendricks' Commercial Register of the United States," for buyers and sellers. 1,128 7½x9-inch pages, cloth bound. $6. Samuel E. Hendricks Company, New York.

This is the twelfth annual edition of Hendricks' directory, and is devoted especially to architectural, mechanical, engineering, contracting, electrical, railroad, iron, steel, mining, mill, quarrying and kindred trades. It contains some 350,000 names, addresses and classifications, and covers pretty fully, from the raw material up, about everything connected with these industries. Although no work of this kind is perfect, and the best trade directory it is possible to compile would be complete only on the date of publication, owing to the number of business changes of all kinds occurring daily, this book will be of considerable value to those who have occasion to consult works of this nature. One feature which will probably give it preference over the general run of trade directories is the grouping by States, in addition to the general classification, of concerns making and handling the most important materials and supplies used in connection with the industries mentioned.

A $100,000 fire at Gallion, Ohio, is believed to have been caused by the spontaneous ignition of oily waste.

It is reported that a commission of inquiry, to consist of about twenty-five members and headed by Alfred Moseley, will soon arrive here from England to study the relations between capital and labor here and the conditions of production. Men representing various trades and occupations will be represented upon the commission.

The Board of Education of New York is doing an excellent and highly commendable work in its courses of free popular lectures which are maintained each winter, the present course being the best yet provided. The lectures are eminent-

ly practical and cover every department of desirable knowledge. The lecturers are well qualified to discours upon their several topics and liberal provision is made for illustrations and experiments. The list of lectures is far too voluminous for us to attempt to reproduce, but those interested will have no difficulty in obtaining all requisite information.

Personal.

John E. Glass, who for two years past has represented in New York *The Ironmonger*, of London, is returning to London to become the publisher of that journal, and the New York office will be discontinued.

Warren A. Waterman, who has been general foreman of the Plunger Elevator Company Worcester, Mass., for the last nineteen months, has been appointed general superintendent of the Standard Plunger Elevator Company, of Worcester, Mass., which is a new and independent company.

Obituary.

Edwin R. Stilwell, of the Stilwell-Bierce and the Smith-Vaile companies, of Dayton, Ohio, died October 8, seventy-five years old. The Stilwell-Bierce firm was formed in 1868 for the manufacture of steam pumps, and in 1876 the water turbine business was added. The employees of the allied concerns now number 1,500, who all attended the funeral.

Commercial Review.

NEW YORK, October 20, 1902.

In machinery circles, in this locality, great satisfaction was expressed with the results of the first annual convention of the National Machine Tool Builders' Association, which was held last week in Cleveland, and which was attended by members or representatives of many of the leading machine-tool building concerns of the country.

Those who attended the convention were pleased with the gratifying reports given in connection with the recent advances in machine tools, all of which were to the effect that these were being well maintained.

The trade here was pleased with the action of the convention in taking up the question of uniformity in price of machines of slightly different sizes made by different manufacturers, quotations of which have been a little too variable in the past to insure a healthy condition of trade. The hope was expressed that the committee appointed to consider the matter would be able to adjust it to the satisfaction of all concerned. In like manner commendation was heard for the proposition to bring the prices of attachments and fittings to machine tools in closer relation to the price of the tools themselves. The only other matter of a strictly commercial character considered by the convention was in the adoption of a resolution, pledging the members of the association to make all sales in the future on the basis of thirty days, net, and discontinuing the practice of making further shipments "on consignments," matters which business conditions make desirable.

The paper read by F. A. Halsey, of the AMERICAN MACHINIST, on the deleterious effects the passage by Congress of the bill providing for the adoption of the metric system would have on the machine-tool industry of the country was the medium of an interesting discussion, which culminated in the convention placing itself on record against the passage of the bill in strong resolutions giving potent reasons why it should not be enacted into law.

Altogether the proceedings of the convention afforded proof, if proof were needed that the organization of the National Machine Tool Builders' Association has supplied a long-felt want in the machinery tool industry, and that the latter will eventually find in the association an agency capable of doing more for its protection and extension than any which has thus far made its appearance.

Importers of steel billets have come in conflict with the government authorities in relation to the proper method of assessing the duty on steel billets purchased abroad, and which has already brought business in that direction to a standstill.

The difficulty has its inception in an order which A. Milne & Co., of No. 1 Broadway, this city, placed in Germany last June for 1,000 tons of German steel billets, for which they paid about 77 marks per 1,000 kilos, the value at the maker's works in Germany.

Recently 300 tons of the order arrived in Philadelphia, and the customs authorities there assessed these on the basis of about 97 marks per 1,000 kilos. This increase enabled the authorities to assess the billets on the basis of $8.96 per gross ton, instead of $6.72 per gross ton, as would have been the case if the price on the invoice had been taken as a basis.

The customs authorities justified their arbitrary action by declaring that the law made it incumbent on them to assess the billets on the price they were commanding on their arrival in this country, and that their advices were that at the time the 300 tons of billets reached Philadelphia they were selling at 97 marks per 1,000 kilos in Germany, hence their action.

Milne & Co. paid the increased duty under protest, and during the past week a hearing was given in the matter before United States General Appraiser Jewell in this city. At this meeting many importers of steel were represented. The importers called attention to the fact that there were two prices for steel billets in Germany. One was that which a pool had established and which was now 95 marks per ton. This was for domestic trade alone. The other price was 65 marks per ton, the present price, and which was intended for foreign trade alone. They contended, therefore, that if they could show—and they expressed their willingness to produce their books, if necessary—that they were buying billets in Germany at 65 marks per gross ton, they were being unjustly treated in being forced to pay duty on the basis of 97 marks per gross ton. The Appraiser reserved his decision. From a reliable source the writer learns that the Appraiser will rule adversely to the importers, who will be entitled in this case to appeal to the Board of General Appraisers, whose action is final. Should they be beaten before both tribunals, the importers will take the matter to the United States Supreme Court. Several of the importers have already engaged counsel as a precaution in the event of such drastic action being necessary.

The matter is of the greatest importance to every manufacturer in the country who does not produce his own steel. At the present time every concern in America producing steel is using all of its output in the conduct of its own business, thus making it compulsory for outsiders to purchase their supplies abroad. At the present time, we learn, and on the most reliable authority, that orders for steel billets abroad aggregate at least 50,000 tons.

Reports from Cincinnati tell of increasing business being done by machine-tool builders. As a result, many of them have been forced to enlarge their producing capacity, either by additions to their shops, or by placing new machinery in them. The Lodge & Shipley Machine Tool Company has made a good-sized addition to its plant, and the Cincinnati Planer Company has recently made purchases of machine tools for its own use. The Bickford Drill & Tool Company, the Cincinnati Milling Machine Company, the Bradford Machine Tool Company, Schumacher & Boye, the Cincinnati Machine Tool Company, the American Tool Works Company and the Mueller Machine Tool Company are doing an exceptionally good business at present. In fact, there isn't a concern in this machine-tool emporium of the West that does not give the same assurance.

The probabilities are that the General Electric Company will award the contracts for the $70,000 worth of tools it intends installing in its works at Schenectady, N. Y., during the coming week. From a reliable source we learn that the Brown & Sharpe Manufacturing Company will share in the order to the extent of about $25,000, and the Niles-Bement-Pond Company for about $18,000. The balance of the order, mostly for small tools, will be distributed among many bidders.

The Philadelphia Pneumatic Tool Company states that its anticipations in regard to the volume of business for the month of September were fully realized, the sales for that month having amounted to 20 per cent. more than any previous month. During the current month the monthly

record for foreign shipments has already been broken, large orders having been received from Great Britain, Germany, France, Italy and Denmark. Mr. Chas. G. Eckstein, the German representative of the company, arrived in New York on the 17th inst., and will probably remain some weeks in this country.

The General Electric Company, through its representative in South Africa, has been awarded the contract for the electrical equipment to be installed in the machine shops of the Natal Government Railways, at Durban, Africa. It provides for 119 motors, varying from 15 horsepower down; six dynamos of 300 indicated horse-power each; three electric cranes, six electric capstans, etc.

The Westinghouse Electric & Manufacturing Company has received an order from the Goodall Worsted Company, of Sanford, Maine, for a 400-kilowatt two-phase alternating-current generator which will be belted to an 800 horse-power Brown engine. The generator will furnish power to all departments of the plant by means of Westinghouse induction motors, and will also provide current through transformers for lighting at 104 volts.

CHICAGO MACHINERY MARKET.

Western representatives of boiler and engine builders are looking for an indefinite continuation of excellent trade, or, as they sometimes express it, through the whole of 1903. These affirmations of faith come in response to the query whether trade is not now falling off somewhat. From some sources of information that is the report, but generally the trade is not inclined to take that view of the situation. The fact is pointed out that inquiries are as numerous as ever and that the shops of the boiler and engine makers are as well filled with work as they have been for some time. But the inquiries are not just now blossoming into orders with the dispatch that has been the wont heretofore. There will perhaps be a more general installation of power this winter than commonly during the severely cold season. Special reasons are leading to that course. One is the scarcity of building material during the summer and the tendency for prices to slightly relax during the dull period of construction work. Another is that in some parts of the West labor will be procurable on better terms for the months now approaching. This is accentuating the tendency for an order to go to that seller of power who can make the most satisfactory deliveries. Hence those makers who are the better able to respond to this condition are doing the greater business. For regular fall installation of power, including municipal and lighting plants, the buying was somewhat earlier than usual, and that element of trade is now practically at an end. Most of the current inquiries come from old and established manufacturers. Of all the inquiries received during this month, by a large maker of boilers, all but two were from prospective buyers, who already have plants in operation. Few large and important contracts for power have been closed during the past month.

Makers of gas and gasoline engines are booked many months ahead, and most of them are getting into larger units. The most notable area of development for the larger engines is of course in the gas belts, where fuel is abundant and cheap. Representatives of this class of power claim, however, an economical operation, with gas at a dollar or more per thousand feet. The tide has turned distinctly from the gasoline to the gas engine, for the reason that the fuel requirements of gasoline automobiles have so grown that the price of gasoline has advanced disproportionately in relation to the cost of gas. A present fertile field for development is in the production of producer gas and some very cheap and satisfactory fuels of that description are said to be appearing on the market. At the same time a line of development of the gas engine is towards an adaptability for the use of this cheap artificial gas fuel.

Quotations.

NEW YORK, Monday, October 20.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:	
No. 1 X	$23 50 @ $25 00
No. 2 X	22 75 @ 23 50
No. 2 plain	22 75 @ 22 50
Southern:	
No. 1 Foundry	22 00 @ 23 00
No. 2 Foundry	21 75 @ 22 50
No. 3 Foundry	21 25 @ 22 75
No. 4 Foundry	20 25 @ 21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11¾ @ 12c.; electrolytic and casting, 11⅝ @ 11⅞c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 27¾ @ 28c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5½c.

Antimony—Cookson's, 9½c.; Hallett's and U. S., 7¼ @ 7¾c.

Lard Oil—Prime City, 80 @ 82c., according to brand and quantity ranging from one barrel up to large lots.

New Catalogs.

Sleeper Engine Company, Montreal, Que. The "Sleeper" engine. Paper folder.

Wm. B. Merrill & Co., Boston, Mass. "Tripp" metallic packing. 7½x9, pp. 16, paper.

Chicago Pneumatic Tool Company, Chicago, Ill. Pneumatic hoists. 6x9, pp. 12, paper.

Nernst Lamp Company, Pittsburg, Pa. "Nernst" electric lamps. 3½x6, pp. 28, paper.

Pittsburg Tool Steel Wire Company, Pittsburg, Pa. Price list of drill rods and steel wire.

Narragansett Machine Company, Providence, R. I. Lockers and wardrobes. 5x7, pp. 31, paper.

National Engine Company, Rockford, Ill. Gas and gasoline engines. 5½x8, pp. 12, paper.

Baldwin Locomotive Works, Philadelphia, Pa. "Oil Burning Locomotives." 6x9, pp. 23, paper.

Star Dynamo Works, Jefferson City, Mo. Direct current dynamos and motors. 6x9, pp. 6, paper.

The Derry-Collard Company, 256 Broadway, New York. Circular descriptive of their plan of selling books.

The Jeffrey Manufacturing Company, Columbus, Ohio. "Jeffrey" water elevators. 4¼x8, pp. 12, paper.

Knecht Bros. Company, Cincinnati, Ohio. The Knecht friction sensitive drill press. 3½x6, pp. 12, paper.

Garvin Machine Company, Spring and Varick streets, New York. List No. 26 of new and second-hand tools.

C. C. Wormer Machinery Company, Detroit, Mich. Power-transmitting appliances. 5½x7½, pp. 52, paper.

American Steam Pump Company, Battle Creek, Mich. "Marsh" boiler feed pumps. 6½x7½, pp. 28, paper.

O. K. Patent Tool Holder Company, Shelton, Conn. Paper folder showing O. K. toolholder and sets of tools.

Standard Blue Flame Oil-Gas Company, Chicago, Ill. Wickless blue flame oil gas equipment. 5¼x7½, pp. 40, paper.

American Blower Company, Detroit, Mich. Catalog 141, "A B C" pressure and volume blowers. 7x8¾, pp. 42, paper.

American Roller Bearing Company, Boston, Mass. "American Roller Bearings vs. Grinding Machines." 6x6, pp. 14, paper.

J. M. Westmacott Company, 157 Orange street, Providence, R. I. Gas furnaces for all purposes. 5½x8½, bound circulars.

The Locke Electric Rock Drill Company, 11-13 William street, New York. The Locke electric rock drill. 6x9, pp. 6, paper.

The Consolidated Schools, 154-158 Fifth avenue, New York. General catalog, containing outline of courses. 6x9, pp. 31, paper.

Carlton Manufacturing Company, 76 Franklin street, New York. "New Idea" calculator, for computing wages. 3x5½, pp. 10, paper.

Morse Chain Company, Trumansburg, N. Y. "Silent Running High Speed Chains for Power Transmission." 6x9, pp. 19, paper.

Schumacher & Boye, Cincinnati, Ohio. Engine lathes. Special circular, descriptive of 36-inch and 42-inch lathes. 6x9, pp. 11, paper.

Garvin Machine Company, Spring and Varick streets, New York. "Special Machinery and Index," catalog No. 14. 6x9, pp. 20, paper.

C. W. Hunt Company, New York. Catalog No. 029, "The Hunt Cable Railway for Handling Coal and Merchandise." 7x9, pp. 20, paper.

Garvin Machine Company, New York. Catalog No. 3. Vertical milling machines, profilers and duplex milling machines. 6x9, pp. 23, paper.

The Lagonda Manufacturing Company, Springfield, Ohio. "Weinland" turbine tube cleaners for water tube boilers. 5x7¼, pp. 16, paper.

Laidlaw-Dunn-Gordon Company, Cincinnati, Ohio. "Deep Well Pumping Machinery and Well Supplies." 5½x8, pp. 31, paper. Also Bulletin No. 503, "Cincinnati Two-Stage Straight-Line Air Compressors."

The R. K. Le Blond Machine Tool Company, Cincinnati, Ohio. Lathes. A large line of engine lathes, turret lathes, gap lathes, etc., with parts and attachments, illustrated and described. 6x9, pp. 67, paper.

Baldwin Locomotive Works, Philadelphia, and Westinghouse Electric & Manufacturing Company, Pittsburg. "Electric Locomotives for Surface Haulage." Profusely illustrated. 6x9, pp. 77, decorated pebbled paper cover.

Detrick & Harvey Machine Company, Baltimore, Md. Open side and extension planers, from 33 in. up; containing also a number of illustrations showing this type of planers in operation. 6x9, pp. 35, embossed paper cover.

Bullock Electric Company, Cincinnati, Ohio. Bullock "N" type motors; bulletin No. 1002. Marine lighting and power sets; bulletin No. 1003. Direct current multipolar motors; No. 1012. Direct current multipolar generators, No. 1013.

The Buckeye Boiler Skimmer Company, Cleveland, Ohio. "Boiler Scale and its Prevention," a description of the method of cleaning steam boilers with the Buckeye Automatic Boiler Cleaner. 6½x9, pp. 12, printed in two colors; paper.

Akron (Ohio) Electrical Manufacturing Company. "Electrical Equipment in Modern Machine Shop Practice." A treatise by F. B. Duncan. Reprint from the Proceedings of the Engineers' Society of Western Pennsylvania, May 1902. 6x9, pp. 17.

Wyman & Gordon, Worcester, Mass. "A Short Story of Sir William Siemans," by Dwight Goddard. This is another of the series of booklets on the lives of eminent engineers which the above company issues from time to time in place of a catalog.

Bremer Machine Tool Company, Kalamazoo, Mich. Power punches and shears, blacksmiths' punches and shears, foot-power presses, forging machines, foot-power hammers, milling machines, trolley wheel machines. 6x9, pp. 30, decorated paper cover.

Canadian General Electric Company, Toronto, Ont. Sockets and receptacles. 5x8, pp. 35, paper. The above company also sends us a serviceable cloth binder, such as it distributes among its patrons for holding the various bulletins, catalogs, etc., issued from time to time.

Calculagraph Company, 9-11-13 Maiden Lane, New York. "The Calculagraph for Cost Keeping in Factories and for Other Purposes," describing the various uses to which the Calculagraph can be put. 5x7, pp. 25, embossed paper cover. Also price list of the Calculagraph.

The Gardner Governor Company, Quincy, Ill. Duplex pumping machinery, pump governors and balanced lever valves. 7x9, pp. 47, paper. Air compressors, air hoists, speed and pressure regulators and air governors. 7x9, pp. 32, paper. Governors, angle and globe valves, exhaust heads. 7x9, pp. 31, paper.

Bethlehem Steel Company, South Bethlehem, Pa. Booklet showing some of the products of the above company, and gotten out as a souvenir in connection with the twenty-first annual convention of the American Street Railway Association, held at Detroit, Mich., Oct. 8, 9 and 10, 1902. 4¼x6½, pp. 16, paper.

Cincinnati Shaper Company, Cincinnati, Ohio. Catalog "A." Showing line of pillar and traverse shapers, attachments and parts; covering full line of single and back-geared crank shapers, rack shapers, electric drive, tilting and revolving tables, traverse shapers with one and two heads, etc.; profusely illustrated by half-tones. 6x9, pp. 47, paper.

Chicago Pneumatic Tool Company, Chicago, Ill. Air compressors. Besides covering the line of air compressors made by this company for use in connection with pneumatic tools and for other purposes, the book contains much valuable data on the subject of installations of compressed air plants and use of pneumatic tools. 6x9, pp. 71, paper.

Cleveland Automatic Machine Company, Cleveland, Ohio. "Cleveland Automatic" chucking, worm milling and screw machines, with attachments for forming and threading multiple parts from rods, bars, castings and forgings. Printed in two colors; half-tone illustrations showing the various machines and examples of the work they turn out. 6x9, pp. 79, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Direct current belted generators; bulletin No. 1025. Enclosed direct current power circuit arc lamps; No. 1028. Enclosed direct current 110-volt arc lamps; No. 1029. Direct current belted motors; No. 1032. Single-phase generators; No. 1030. Standard small motor panels; No. 1034. "Wood" measuring instruments; instruction book No. 3011, 4½x6½, pp. 15, paper.

The Link-Belt Engineering Company, Nicetown, Philadelphia, Pa. The Renold silent chain gear, showing the adaptability of this chain for machine tool gearing, driving purposes, etc. Illustrated by cuts from photographs of chains and sprocket wheels in actual service. 3½x6, pp. 32, paper. Bulletin No. 1001, "The Renold Silent Chain Gear in Connection with Electric Motors," showing various applications.

Crane Company, Chicago, Ill. Complete pocket catalog of steam fittings, including valves and fittings for extreme high pressure, iron gate valves, brass globe valves, etc., for medium pressure; iron gate valves and flanged fittings for low pressure, and hydraulic pressure valves and fittings; covering, also, steam and gas fitters' tools, engineers' supplies, hose goods, wrought pipe, etc. 4x6½, pp. 464, cloth.

The Goulds Manufacturing Company, Seneca Falls, N. Y. This catalog covers the full line of power pumps made by the above company, including single-acting triplex plunger pumps, single and double acting triplex piston pumps for all purposes, mine pumps, pulp and paper mill pumps, rotary fire pumps, centrifugal pumps, air compressor and vacuum pumps, working heads for deep well cylinders, well cylinders, pump driving connections, electric pumps and connections, etc., etc. Profusely illustrated by half-tones. 7x8, pp. 160, embossed paper cover.

Manufacturers.

The Birmingham (Ala.) Ice Factory Company will build a plant.

J. P. Ridge, of Woodsfield, O., has decided to manufacture oil well tanks at Marietta.

A stone-crushing plant is to be erected at St. Paul, Minn., for the James Forrestal Company.

The I. Stephenson Company, Wells, Mich., is building a large flooring manufacturing plant.

It is reported that the "National Pulp & Paper Company" will establish a plant in Waterloo, Ia.

The Treat Manufacturing Company, Hannibal, Mo., will build an addition to its car-wheel foundry.

It is understood that J. D. Bassett, of Bassett, Henry County, Va., and others will erect a furniture factory.

The Symons Iron Foundry is being built at Centralia, Wash. It will be equipped to do all kinds of mill repairing.

A new four-story factory is being built for Platt Brothers & Co., manufacturers of metal buttons, etc., Waterbury, Conn.

The Hamilton (Ont.) Model Works find it necessary to enlarge their plant, owing to the demand for their marine engines.

A large factory is to be constructed in Jersey City, N. J., by the American Type Founders Company, of New York city.

The contract has been awarded for a three-story building, 49x100 feet, for the Rochester Clay Pot Company, Rochester, Pa.

The Vulcan Steel Company has purchased four acres at Aliquippa, Pa., and has arranged for an addition to its plant.

W. H. Frost has decided to enlarge the Smith's Falls (Ont.) Malleable Iron Works by the addition of a building, 66x250 feet.

The W. F. & John Barnes Company, manufacturer of metal and wood-working machinery, Rockford, Ill., is erecting an addition.

The Mesta Machine Company, of Pittsburgh, Pa., has purchased two acres of ground for additions to its plant at West Homestead.

The Standard Roller Bearing Company, Philadelphia, Pa., has moved its office to its new factory, Forty-eighth and Girard avenue.

The Field Force Pump Company, of Lockport, N. Y., manufacturer of sprayers and filters, is fitting up a plant at Elmira Heights.

The E. Ingraham Company, manufacturer of clocks, Bristol, Conn., has asked for a permit to build a new factory building, 220x40 feet.

We understand that it is proposed to enlarge the capacity of the plant of the Alabama Portland Cement Company, Demopolis, Ala.

The Rock Island (Ill.) Iron Works, manufacturing, among other things, the Walsh brake shoe, will build a new plant, 80x300 feet.

Kraus & Co., of Pittsburgh, Pa., have purchased properties in Baltimore, Md., and contemplate building a large shoe manufacturing plant.

Additions and alterations, including a boiler-house, are to be made to the plant of James Pollock & Son, carpet manufacturers, Philadelphia.

Scheeler's Sons, wire manufacturers, Buffalo, N. Y., have received a building permit to erect a four-story brick factory, which will cost $16,000.

We are informed by Herrick Bros. that the machine shop they are erecting is situated at Bethel, Me., instead of West Bethel, as stated at page 1465.

The Automatic Electric Company, Chicago, Ill., announces the removal of its business to its new building, corner of Van Buren and Morgan streets.

The plant at Versailles, Pa., of the Encaustique Metal Interior Company, Pittsburgh, is reported to have been destroyed by fire. It is to be rebuilt.

The Board of Trade of Oxford, Pa., is negotiating with the Mason Multiple Plate Washer Company to erect a manufacturing plant in that place.

It is reported that the Vincent Valve Company, Inc., Sandusky, O., has under consideration plans for an addition, 100x40 feet, to be used for a brass foundry.

It is stated at Detroit, Mich., that plans have been made for a manufacturing building, 56x200 feet, for the Lansing Wheelbarrow Company, of Lansing.

The firm of Maddock & Herschell, Princeton, Ind., has purchased a lot adjoining their

machine shop with a view of erecting a new shop building in the spring.

C. A. Stone, of Philadelphia, is establishing a machine and repair shop in Stroudsburg, Pa. He proposes to manufacture lathe center grinders and small machines.

Ground has been broken at Canandaigua, N. Y., for power-house, car barn and shops of the Rochester & Eastern Railway. The power-house equipment has been ordered.

The contract has been awarded for building a polishing mill of the Granite Railway Company, Quincy, Mass. The building will be 157x54 feet. It will have six machines.

Work is about beginning on the Carolina Steel Bridge Company's plant at Burlington, N. C. They will erect an office building in addition to three buildings already secured.

Work has been started by the Weston Electric Instrument Company on the erection of an engine and boiler room extension to one of the buildings at its plant at Waverly Park, N. J.

Orders have been received by local officials at Laramie, Wyo., to begin work on improvements in the Union Pacific shops, an appropriation of $10,000 having been made for the purpose.

The International Cement Company has purchased a site for a plant at Elizabeth, Pa. The general offices of the company will be in the Second National Bank Building, Pittsburgh.

It is stated that the Elwood plant of the Anderson Foundry & Machine Works, of Anderson, Ind., will be considerably enlarged next spring. The Anderson plant is to be almost doubled.

The bridge plant of the Indiana Bridge Company, Muncie, Ind., will be rebuilt and doubled in size during the coming year. Between $25,000 and $50,000 will be spent in improvements.

Improvements to its plants on the Wisconsin River are contemplated for next year by the George A. Whiting Paper Company, Menasha, Wis. The improvements may include the building of a new pulp mill.

The Deane Steam Pump Works, at Holyoke, Mass., of the International Steam Pump Company, have just been enlarged by an addition to the foundry, and now an 80x100-foot machine shop addition is being considered.

E. L. Wright, of Hancock, Mich., president of the Columbia Gold Mining Company, has been in Helena, Mont., to determine on the advisability of rebuilding the company's burned plant at York, on a much larger scale.

The Town Council, Peterboro, Ont., is considering a proposition from the Skelton Manufacturing Company as to locating there for the manufacture of brass goods, shovels, spades, picks, scythes and other classes of gardeners' and miners' tools.

The plant of the Union Furnace Manufacturing Company, Union Furnace, Pa., in which a fire occurred, is being rebuilt. The old shovel factory had a capacity of 100 dozen shovels per week and the new one will have a capacity of 150 dozen.

The Burrows Manufacturing Company, of Williamsport, Pa., has been purchased by a party of York capitalists, headed by Daniel F. Lafean. The company owns certain patents for regulators used on steam boilers. Shops will be erected at York.

S. H. Bradley, of Olean, and G. B. Bullis, of the Buffalo, Attica & Arcade Railroad at Arcade, N. Y., representing a company who put down the well at Johnsonsburg, Wyoming County, are making preparations for the erection of a 300-barrels-a-day salt plant.

The W. S. Tyler Company, Cleveland, O., manufacturer of wire cloth and ornamental iron work, has increased its capital stock from $500,000 to $1,000,000, in order to carry out improvements. The power plant and the number of looms will be increased.

The Milwaukee plant of the Illinois Steel Company, a part of the United States Steel Corporation, will, it is said, together with the plants at Chicago and Joliet, be improved to the amount of several million dollars when certain financial arrangements are put through.

The National Machinery Company, of Tiffin, Ohio, manufacturer of bolt, nut and wire nail machinery, has just purchased five acres of land adjoining its plant in anticipation of extensive improvements, which will soon become necessary on account of its increasing domestic and foreign business.

It is announced from Sharon, Pa., that the Standard Engineering Company has been formed, with $300,000 capital, by some of the officials of the National Tube Company and United States Steel Corporation, and a plant will be erected at Ellwood City for structural and engineering work.

It is stated from Marysville, Cal., that Joseph Finnell has been working to secure capital for the establishment of a beet sugar factory in that section, and the plant will shortly be built between Tehama and Corning. The Northern California Power Company will furnish electricity to run the machinery.

It is reported that the Jones & Laughlin Steel Company, Pittsburgh, Pa., is considering an issue of bonds for $10,000,000 to carry out large improvements and additions to the works. Within a year it is expected that the company will have a capacity for turning out 1,200,000 tons of steel annually.

The Crescent Novelty Company, Chattanooga, Tenn., manufacturer of coal gas and acetylene light tips for burners, is establishing a plant near Orange Grove. The company is now located in the same building with the Ornamental Iron & Wire Company, which later will treble its capacity and install machinery in the entire building.

It is stated at Charlotte, N. C., that the Ware Shoals Manufacturing Company, which was recently organized to build a $500,000 cotton mill at Ware Shoals, on the Saluda River, in South Carolina, has begun the work of development. Also that R. S. Hill is at the head of a company that will build a 25,000-spindle mill at Anderson, S. C., at a cost of $600,000.

If certain requirements are met there will be established in Decatur, Ill., the Decatur Bridge Company, which will manufacture iron and steel and do construction work of that kind. The men who will own and operate the factory are W. M. Wood, George A. Caldwell, Edgar B. Tyler and Thomas L. Blackburn, all of Muncie, Ind., and all formerly connected with the Indiana Bridge Company.

A steel casting company has been organized at Colorado Springs, Colo., to build a plant. About $200,000 will be expended. The company is capitalized at $500,000. The incorporators are John I. Franklin, C. F. Springer and James K. Vanatta, and these, together with F. J. Hobbs and John F. Sanger, compose the Board of Directors. Mr. Springer is a practical steel man.

A tract of land just outside of Chattanooga, Tenn., at the base of Lookout Mountain, has been sold by the Leighton & Howard Steel Company, of St. Louis. It is said that the purchasers are representatives of the Alabama Steel & Wire Company, that a large furnace will be built at once, and that it is thought a steel mill will be built later. Joseph Schwab, of New York, brother of Charles M. Schwab, is interested in the deal, and according to one account the deed was made to him.

The annual meeting of the stockholders of the Sprague Electric Company was held Tuesday, October 14, 1902, at the office of the company in Watsessing, N. J. The following directors were elected for the ensuing year: Messrs. Allan C. Bakewell, D. C. Durland, S. M. Hamill, J. R. Lovejoy, John Markle, J. R. McKee and E. G. Waters. At a meeting of the directors officers were elected as follows: President, Allan C. Bakewell; first vice-president, S. M. Hamill; second vice-president, D. C. Durland; secretary and treasurer, Harry R. Swartz.

The Star Corundum Wheel Company, Detroit, Mich., whose corporate existence was recently dissolved by the sale of its property and franchises, has been succeeded by the "Star Corundum Wheel Company, Limited," and the offices and factory have been removed to 224 Twenty-first street, where the floor space has been doubled and additional equipment installed. John R. Kempf, manager of the old company, will continue in a similar capacity in the new one. The capital of the company has been increased, thereby enabling it to carry a larger stock than heretofore.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book, "Dies and Diemaking," 100 6x9 pages, $1, post paid; send for index. J. L. Lucas, Bridgeport, Conn.

Exporters to Germany, desiring catalogs translated, will find it profitable to address E. O. Reuleaux, Mech. Eng., Wilson, Pa.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 129, AMERICAN MACHINIST.

Sublet part of hurry contract to Industrial M. Co., Newark, N. J., or 608 Western ave., Lynn. Parts of machines and light mach'y.

Wanted—A first-class machinery molder for high-grade work in small foundry; $500 to $1,000 stock required. Address D., care A. M.

For Sale—Iron foundry located within 40 miles of Pittsburgh, Pa.; now running at full capacity and large trade to draw on. Box 104, AMERICAN MACHINIST.

For Sale—Working drawings stationary type steam engine, 1 to 40 H.-P., eight sizes; first class in every particular; rare opportunity. Box 134, AMERICAN MACHINIST.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—Light machine work and special machinery to build to order, special tools, dies and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

For Sale—New foundry, completely equipped, 60x380, on Erie Canal and Delaware & Hudson Railroad, near Albany; also complete machine shops and forging plant at Troy. Address Pneumatic Signal Company, Broad Exchange, New York.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Agency wanted for specialties, by established English firm calling on all classes of tool dealers; grinding or polishing materials preferred; American references; principal will be in New York in October. Address Box 99, AMERICAN MACHINIST.

A Middle West manufacturer of standard machine tool in extensive use and bearing excellent reputation, wants man acquainted with New York machine tool trade; preferably (not necessarily) one now established and having storeroom; opportunity to represent other good makes; communication confidential. Address Box 96, AMER. MACH.

Young man, first-class mechanical and executive ability, good general, all-around machinist, first-class draftsman, familiar with up-to-date foundry practice, wishes to hear of an opportunity where he could invest a few thousand dollars; jobbing shop preferred; would not object to any part of the West, so long as the enterprise is in a locality where business can be secured. Box 94, AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman desires position. Box 125. AMERICAN MACHINIST.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Experienced mechanical draftsman desires position. Box 92, AMERICAN MACHINIST.

Experienced mechanical draftsman wishes to change position. Box 140, AM. MACH.

Draftsman with experience wishes position; electrical line preferred. Box 135, AM. M.

Mechanical draftsman, graduate, 3 years' experience, wants position. Box 138, AM. M.

Foreman patternmaker desires change; experience: executive ability; references. Box 123, AMERICAN MACHINIST.

Experienced pattern foreman on medium heavy machine tools desires position. Box 124, AMERICAN MACHINIST.

Mechanical engineer and draftsman, age 22, technically graduated in Norway, wants position. Box 128, AMERICAN MACHINIST.

Draftsman, Swede, lately landed, 6 years' experience in machine shop and drawing room, wishes position. Box 137, AM. MACH.

Experienced mechanical draftsman, graduated abroad, wants position; engine works preferred. Box 141, AMERICAN MACHINIST.

First-class general toolmaker and designer (33), on small interchangeable work, wishes a change, in or around New York. Box 130, AMERICAN MACHINIST.

Technical graduate, Swede, with 6 years' shop and draftsman's experience, principally in steam fittings, desires position. H. B., 231 Union street, Brooklyn.

Position wanted as foreman of machine shop; experienced on tool machinery, experimental work; up-to-date methods; 24 years' experience; 38 years of age. Box 133, A. M.

A young man, at present superintendent of shop engaged in the manufacture of interchangeable machinery, wishes a change; particulars on request. Box 142, AMER. MACH.

Expert mechanical draftsman, of 35 years' experience, has lost position through failure of company, and desires to become associated with some company or firm who value ability and experience. Address Box 121, AM. M.

Draftsman and designer, young man, also first-class experimental machinist and patternmaker, experienced on gas and oil engines and possessing a practical knowledge of electricity, desires position of responsibility, as draftsman. Box 126, AMER. MACHINIST.

A position as general superintendent, by a thorough, up-to-date superintendent and M. E.; 15 years' experience; accustomed to engines, air compressors, gas engines and steam pumps; knows every detail from the pig iron to the finished product. Address Box 131, AMERICAN MACHINIST.

Mechanical engineer, 30, wants position as superintendent, master mechanic or chief draftsman; live man with 8 years' practical experience, special and mill machinery, tools, jigs, etc.; at present C. D. with large manufacturing company; write and get my references. Box 122, AMERICAN MACHINIST.

Mechanical engineer, technical graduate and expert designer, desires change; 8 years' experience as M. E., chief draftsman and superintendent, in power plant installation, power transmission, shop management and design of light, heavy and automatic machinery; best of references. Address Box 71, AM. MACH.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACHINIST.

Machine shop foreman, at present employed, desires to make a change; 12 years in present position handling from 70 to 80 men on heavy and medium machine tool work; would like position with firm building large marine or water-works engines; capable of filling position of general foreman or shop superintendent; first-class references if required. Address Box 127, AMERICAN MACHINIST.

Mechanical engineer, graduate Mass. Inst. of Technology, with shop and drafting-room experience in modern shop making interchangeable work, would like change in position; has had experience in handling work and men under both piece-work and premium systems and in estimating on contract work; can design jigs and lay out manufacturing processes; position as superintendent or assistant superintendent preferred. Address Box 139, AMERICAN MACHINIST.

Help Wanted.

Machinists—Your working drawings made by G. M. Mayer, M. E., Monadnock, Chicago.

Wanted—Two first-class electrical draftsmen. Box 143, AMERICAN MACHINIST.

Wanted—First-class vise and machine hands. Address, giving experience, etc., Kempsmith Manfg. Co., Milwaukee, Wis.

Wanted—Non-union molders; good wages and steady employment. Address Ridgway Dynamo & Engine Company, Ridgway, Pa.

Wanted—A draftsman thoroughly familiar and experienced in designing special jigs for heavy machinery. W. Co., care AM. MACH.

Wanted—A good machinist in each machinery center, to act as local agent in putting our tools on the market. Address Box 119, A. M.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Machinists, send for free blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—All kinds experienced engineers, draftsmen; send stamp to register; positions open. Cleveland Engineering Agency, Box 71, Station B, Cleveland, O.

Wanted—Positions for experienced men, and men for such positions. Address James Brady (late Brady Mfg. Co.), Room J, 20th Floor, 220 Broadway, New York.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Capable foreman, by machine tool company in Middle West; must lay out work on millers, lathes and gear cutters for 25 apprentices. Box 144, AMER. MACHINIST.

Wanted—At once, two mechanical draftsmen; those having had experience on hydraulic machinery, cranes, punches and shears preferred. Box 97, AMER. MACHINIST.

Wanted—First-class office man; one familiar with hardware or machinery business preferred; give age, experience, references and salary expected in answering. Box 120, A. M.

Master mechanic wanted; thoroughly familiar with mining and electrical machinery; write fully, stating age, experience, names of former employers and salary expected. Address Box 51, AMERICAN MACHINIST.

Superintendent wanted for foundry employing 100 molders; prefer one familiar with pump and gas engine work; good position for capable man; give references and experience in full. Address Box 112, AMER. MACH.

Wanted—Four good machinists for work on weaving and general machinery; steady, light work; good wages; 50 miles from Chicago. Address promptly, with particulars, Western Cane Seating Co., Michigan City, Ind.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—First-class patternmaker, also young man of mechanical ability who has served 1 or 2 years' apprenticeship patternmaker, who desires to complete learning trade under first-class instruction. Great Western Mfg. Co., Leavenworth, Kansas.

Wanted—By a company engaged in manufacturing railway specialties, an experienced draftsman, competent to produce working drawings for shop use from general instructions by engineer; steady position to good man. Address Box 118, AMER. MACHINIST.

Machine shop foreman in manufactory of engines and threshing machinery, located in Indiana; must be experienced acquainted with modern methods and able to handle men; in answering give references, experience and salary expected. Box 107, AMER. MACHINIST.

Wanted—By a manufacturing company in railway line located in the Middle West, employing 400 men, a thoroughly up-to-date foundry foreman who is progressive and capable of getting out work at the lowest possible cost. Address Box 117, AMER. MACHINIST.

Wanted—Machinists, toolmakers, floor hands, bodymakers, painters, trimmers and blacksmiths; we have just moved into our new factory and will double our present force; good wages and 9 hours' work. Address Fournier-Searchmont Automobile Company, Trainer, Delaware County, Pa.

Engineering.—Wanted—An experienced and capable all-round office man familiar with steam, electrical and pump work; capable of assuming charge of the office side of same and possessing some ability as a salesman. Apply by letter, in confidence, stating qualifications, experience and salary expected. De Laval Steam Turbine Co., 74 Cortlandt st., New York City.

Wanted—Superintendent with up-to-date ideas of manufacturing, for a machine shop employing from 50 to 100 men; must be acquainted with latest shop practice and methods; good executive ability in getting out work and handling men; conversant with foundry management preferred; state age, experience, references and salary; position permanent to good man. Address Box 603, Guelph, Ont.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

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Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.

Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

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Barrels, Steel

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Cleveland Twist Drill Co., Cleveland, O.
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Bearing Metal

Phosphor Bronze Smelting Co., Philadelphia, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
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Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Mchry. Co., Tiffin, O.
Reade Mchry. Co., Cleveland, O.

Blocks and Tackles

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers

Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Books, Mechanical

Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.
Van Nostrand Co., D., New York.

Bulldozers
National Mchry Co., Tiffin, O.

Carborundum
See Grinding Wheels.

Car Link Machines
National Machy. Co., Tiffin, O.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Allegheny Fdry. Co., Warren, Pa.

Castings, Motor
Graves Motor Mfg. Co., St. Paul, Minn.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London Conn

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Eastern Mchry Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co.,, St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provl., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co.,, St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Delivouk & George, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Troy File Works, Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Delivouk & George, Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Enginering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Co., Wm., Cincin., O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Brown & Sharpe Mfg. Co., Providence, R. I.
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co. Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.

Motors, Electric—*Continued*
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Frothingham, N. L., New York.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Machinery Exchange, Chicago, Ill.
Prentiss Tool & Supply Co., New York.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Engr. Works, Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bellyouk & George, Chicago, Ill.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting,
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co. T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry Co., Chicago, Ill.

Second Hand Machinery—*Cont'd*
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

A Job of Case Hardening.

BY E. R. MARKHAM.

Having occasion a few weeks ago to call at a shop where they were having trouble with their case-hardening, I thought possibly some of the readers of the AMERICAN MACHINIST might be interested in a description of the trouble the parties were having and of the method taken to get out of it.

The pieces to be hardened were small, and while the outside surfaces were required to be extremely hard to resist frictional wear, they were also subjected to a great strain. The pieces were made of an uncertain grade of machinery steel bought at a warehouse in the city where the shop was located. The work was packed in the customary iron box, with the packing generally used, namely, granulated raw bone. They were run in the fire for a given length of time and dumped into a barrel of water. When they were taken from the bath they showed a good average—that is, some of the pieces were hard, some were soft, and some seemed about right—but the parties being somewhat particular, they were anxious that they should all be right.

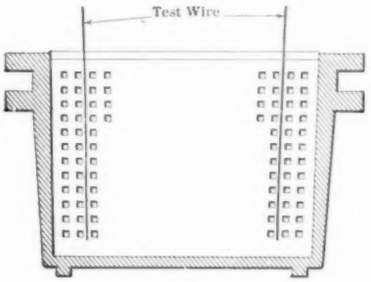


FIG. 1

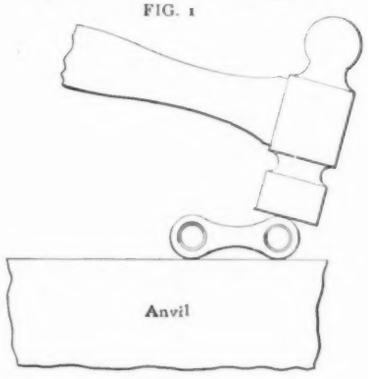


FIG. 2

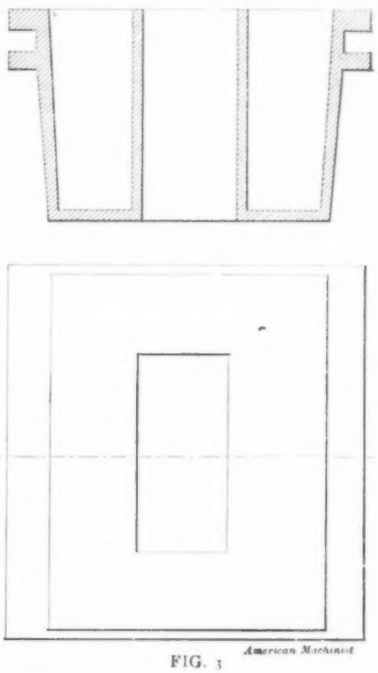


FIG. 3

A JOB OF CASE HARDENING.

An examination of the boxes in which the work was heated showed them to be much too large for the purpose, because when packed with work the pieces in the center of the box would not have become red hot when those near the sides were sufficiently charged with carbon to harden in a satisfactory manner.

I suggested as an experiment that they pack the boxes with three or four rows of work around the outside, as shown in Fig. 1, filling the center of the box with charcoal or expended bone and running test wires down through the centers of these rows in order to ascertain the exact time when the pieces became red hot.

The boxes were placed in the furnace and after being there one hour one of the test wires was drawn. It did not show any trace of red, so we waited a while and drew another, and when one was drawn that showed red we timed from then. The work was allowed to run thirty minutes after it was red. Before dumping the contents of the box into the barrel, a piece of wire screen cloth was cut to the shape of the inside of the barrel and tacked to a hoop. It was placed in the barrel, blocking it up from the bottom with pieces of brick. A hole was bored through the bottom of the barrel and a pipe run from the water supply to the barrel and up through the hole in the bottom. The barrel, by the way, was out of doors in the shop yard. A 2-inch hole was bored in the barrel about 4 inches from the top for an overflow.

The box was taken to the barrel and the contents were sifted into the water a little at a time rather than dumped in a body. The jet of water coming up from the pipe through the bottom was spread by the screen cloth. The work, being dumped gradually, was separated from the packing material, and the pieces of work were separated from each other, thus insuring the hardening of each individual piece. As the pieces had formerly been packed, those nearest the outside of the box became overcharged with carbon by the time the pieces farther in were sufficiently charged, while those in the center of the box were not sufficiently charged to harden at all. Then, when they were dumped, the box was turned bottom side up over the barrel and the contents went into the water in a lump. To be sure the mass separated somewhat before it reached the bottom, but it remained intact to such an extent that a great many of the pieces the water could not get at.

At one time I had charge of work in a shop where several thousand chain links were case-hardened each day. Now, a chain link, in order to stand the test to which our inspectors subjected them, made the case-hardening a job that required a great amount of watching. At first we packed them in large boxes, filling the box with the links and packing material, but our results were anything but satisfactory, as the chains were subjected to a strain of 1,700 to 2,000 pounds, and a few of the links were taken at random from each lot hardened and tested with a hammer. The link was laid on an anvil and struck over the rivet hole with a hammer, as shown in Fig. 2. It was necessary that the link should break and stretch at the same time; that is, it shou'd not break from the effects of the blow without stretching, neither should it stretch without breaking, but should stretch and break at the same time, and this from a blow of a hammer in the hands of a man trained until he knew exactly how hard he must strike. We had testing machines in our experimental department, but we found that our man trained to this work could tell the condition of the links as well with the hammer and at a much less expense.

When we experienced the difficulty mentioned we tried packing a few rows around the outside, as shown in Fig. 1. This worked very satisfactorily. Then we made boxes of the form shown in Fig. 3, thus insuring very uniform results. I mention the chain links because I am not at liberty to illustrate the pieces mentioned first, and the links will serve the purpose as well.

It was also necessary to color the chain links, and we found the following mixture worked very well. It not only gave them sufficient hardness, but left them tough and colored them nicely. I copy this from one of my old record books.

Regular Mixture for Hardening 99 Model Chain Links.—Mix equal quantities of animal charcoal and granulated hardwood charcoal. Take 10 scoops of this mixture, add ½ scoop of granulated charred leather, mix thoroughly and pack the links in this mixture, being sure that they do not touch each other. Run 45 minutes after they are red hot, and then dump in cold water, being careful to so dump the boxes that the work is not dropped in a body.

German Law Against Unfair Competition.

United States Consul Warner sends from Leipzig an account of the German law against unfair competition in business. He says that Germany has gone farther than any of the other countries, fighting the evil with the criminal as well as

the civil law. The principal misdemeanors considered in this law are:

1. Fraudulent advertising—*i. e.*, false declarations concerning methods of production, make-up or prices of wares; source of supply; reason for selling; possession or ownership of trade-marks. In the above cases, every business man or group of business men has the right to bring suit against the offending party, calling for the suppression of the above practices, also for damages. A fine not exceeding 1,500 marks ($357) can be imposed; repetition of such an offense is punishable with imprisonment not exceeding six months.

2. Detraction of a competitor—*i. e.*, spreading false reports concerning the trade of another, his person, the manager of his business, or his wares. Offenses of this nature are punishable with a fine not exceeding 1,500 marks ($357), or imprisonment not exceeding one year.

3. Misusing another's name in such a way that an unfair advantage is gained. Offending parties must pay damages and are compelled to discontinue such practices.

4. Disclosing business secrets during time of employment. A fine not exceeding 3,000 marks ($714), or imprisonment not exceeding one year can be imposed, and in addition, judgment of damages sustained. Any competitor using information gained in this way, as well as any third person disclosing such information to him, is liable to a similar punishment.

5. Deception as to the quality of goods. The Federal Diet has been empowered to prescribe that certain articles are to be sold at retail only in certain quantities, lengths, according to certain numbers, etc., or with declarations as to number, weight, etc. The punishment for every infringement shall not exceed 150 marks ($35.70).

As regards the effect of the law briefly described above, the Berlin Society of Business Men and Manufacturers says that up to the present time it has been very beneficial. This effect is ascribed to the strictness with which the law is enforced.

Calculating the Weight of Castings.*

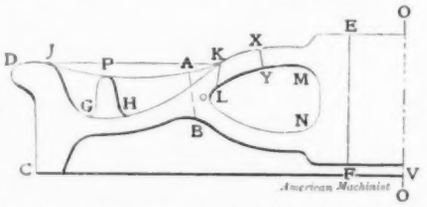
The object of this graphic method is to estimate the weight of the casting, which is to be made from a given pattern when the cross-section is not a uniform geometrical figure. Such an estimate is a very important guide to the foundryman, who would otherwise guess the probable weight of a casting of new design, and, in trying to be on the safe side, would probably melt an unnecessary amount of iron. It is also an aid to the designer of a new car-wheel pattern, who must otherwise estimate from general experience the probable weight, have test wheels made, and correct the pattern afterwards, so as to obtain the weight prescribed.

For the method here described, an accurate drawing of the pattern is employed. This gives a closer result than a drawing of the wheel itself, for the following reasons:

Calculations based upon the accurate dimensions of the wheel involve the erroneous assumption that the specific gravity of the casting is uniform throughout; and upon that basis the calculated weight would be wrong, because the amount of metal poured has shrunk in the mold, acquiring the highest density in the outside chilled portion, and growing less dense through the mottled to the gray portions.

Calculations based upon the dimensions of the pattern or "chiller" assume that the cooled metal will not have shrunk, but will have the volume of the pattern and uniform density.

These assumptions, though erroneous, counterbalance each other. For instance, the patterns and the chiller which give a wheel of 33 inches diameter when cold are respectively 33.5 inches in diameter. This shows a shrinkage for wheel iron of about 3-16 inches (ordinary gray pig is commonly assumed to shrink about ⅛ inch) per foot. Wheels cast in 33.5 chillers do not always have the same diameter. They may vary ⅛ inch either way by reason of difference in composition, pouring temperature, duration of pouring, and probably also slight variations in cooling. But the average diameter is 33 inches; and it is found that a calculation based upon the 33.5 inch pattern, and the assumed uniform density of 0.26 pound per cubic inch of molten wheel iron, as it fills the mold, gives correct weights of the wheels, even though the latter vary in size, as before explained.



CALCULATING THE WEIGHT OF A CAR-WHEEL CASTING.

For a casting of uniform specific gravity, either the drawing of the casting or that of this pattern could be used. If the latter, then a percentage for shrinkage must be subtracted.

Fig. 1 shows, in reduced size, half the cross-section of the pattern of an ordinary cast-iron car wheel. From the full-sized drawing, divided as shown in the figure, the areas *A B C D* and *E F B A* are taken with the planimeter, and the area *L M N*, similarly determined, is subtracted from their sum. The remainder is the area of the half-section of the pattern, exclusive of the brackets. Let this area (in square inches) be called *A*.

A blueprint is then made, pasted on cardboard, cut along the lines *D E F C D* and *L M N L*, and then balanced on a pin point, to determine the center of gravity of the irregular figure. This print (*o* in Fig. 1) is located on the tracing, and its distance from the center line of the wheel axis *O o* is measured. Let this distance (in inches) be *R*. If $w = 0.26$ pound be taken as the weight of the metal per cubic inch, and *W* as the weight of the wheel, then $W = 2\pi R \times A \times w +$ weight of brackets and letters, minus weight of metal displaced by the core legs of the pan core. The following calculation for two wheels is given as an example.

The calculation for $2\pi R \times w$ was as follows:

	No. 1	No. 2
Area of *E F C D*, sq. in...	52.38	53.17
Area of *L M N*, sq. in....	12.42	9.60
Net area *(A)*, sq. in..	39.96	43.57
R, inches.....	9.38	9.25
Cubic contents of pattern $2\pi R \times A$, cu. in.....	2353.6	2531
Weight (cubic contents × 0.26), pounds.....	611.95	658

The requisite addition for weight of brackets is approximately calculated as follows:

	No. 1	No. 2
Area *G P H*, sq. in.....	2.24	2.30
Assumed average, ½ *G H P*, sq. in.....	1.12	1.15
Average length, measured on curve, inches.....	10.5	10.25
Volume of one bracket, cubic inches.....	11.8	11.8
Weight (vol. × 0.26), lbs..	3.06	3.06
Weight of 13 brackets, lbs..	39.78	....
Weight of 15 brackets, lbs...	....	45.9

Note: The 650-pounds wheels have 13, and the 700-pound wheels 15 brackets.

The weight of the letters was obtained by weighing the same letters cast in lead, and taking 7-10 of the result as correct for iron. This gave, for each wheel, 1.2 pounds.

The amount to be subtracted for the metal displaced by the core legs was calculated as follows:

	No. 1	No.
Thickness (*x y*) of bottom plate, inches.....	29-32	1 3-32
Approximate average diameter of core legs, in.....	2⅜	2⅝
Area of base equiv. cylinder, sq. in.....	4.4	5.9
Vol. of equiv. cylinder, cu. in.	4	6.5
Weight (vol. × 0.26) for one core leg, lbs.....	1	1.7
Weight (vol. × 0.26) for 3 core legs, lbs.....	3	5.1

The final net weight for each wheel was determined as follows:

	Pounds.
No. 1. $611.95 + 39.78 + 1.2 - 3$	$= 649.93$
No. 2. $658 + 45.9 + 1.2 - 5.1$	$= 700$

The calculation for No. 1 was made from the pattern drawing for a 650-pound wheel; that for No. 2 from the pattern drawing for a 700-pound wheel. The cleaned wheels from these patterns are averaging 655 and 700 to 705 pounds, respectively.

*C. M. Schwerin before American Institute of Mining Engineers.

A variation of 2 per cent. above or below the regular weight can be easily caused by variable molding in the making of a car wheel. It will be seen that the foregoing method of calculation gives reliable results. For castings of soft iron, and of more regular shape than car wheels, even better results could be obtained.

35-Ton Bushing Press.

The half-tone shows a 35-ton press brought out by the Watson & Stillman Company, of New York city. This press was designed for forcing linings into steel pump cylinders in the United States navy yards, but is now used also for forcing bushings, mandrels and other work of a similar nature.

The press is an open-jaw design, the body being a steel casting. The size of the bed plate is 28x24 inches. The depth of the jaw from the center of the ram is 12 inches, and the clear opening of the press when the ram is returned in the

35-TON BUSHING PRESS.

cylinder is 36 inches. The ram is 3¼ inches in diameter, and has a motion of 8 inches. An independent pump is mounted on the side of the press for the purpose of exerting the maximum pressure of the tool.

The lever shown at the side of the cylinder is for quickly forcing the ram to the work and returning it to the cylinder after the complete operation of the press. As the press is mounted on four wheels it may be readily moved about the shop, thus making it unnecessary to transfer heavy work to the press.

Echoes from the Oil Country.

SHOP NOMENCLATURE.

Not the least among the puzzles that the new beginner finds in the shop are the names of things and the modes of expression he runs up against. While it may be a little reducing in its action on one's pride to be sent chasing around in quest of a "half-round" square and lead him to think it is a put-up job when he is told to go after the "center" square, yet I think that there may be a useful side to it in calling attention to the fact that all the names and terms used are not in accordance with the latest dictionary.

A little effort to improve on the usual custom may also demonstrate that those terms in general use are fastened pretty solidly, and often it is found that the improvements are only such in the mind of the improver.

The man that first put the name to a certain cut of file may have had trouble in finding anyone who would own to having cut it, and while the term he used to express his idea of the cut may have been a trifle crude, yet the man who from modesty should call for an "illegitimate" file would be more apt to get the laugh than the file he was after. "Flat bastard" may not be elegant, yet it is likely it will be sometime before it is obsolete in the shops.

It doesn't take much thought to understand where "morphidite" came from, and "divider calipers" and "caliper dividers," as they are sometimes called, do not seem to gain ground very fast.

Some of the hardest things to get clear in the mind are the terms used in various ways. Most boys around a job shop have had times with the "Old Man."

"Say, come over to the foundry right away quick; the man that is mending that big iron box they pound the sand into wants you right off."

"What business has he to want me, I'd like to know? They are in a hurry for this job, and I won't leave it unless the boss says so. You'd better speak to him."

"Mr. Osborne, the man you put me to helping at the foundry sent me over for the old man, and he says he won't go unless you say so, and they are in a hurry over there. What will I do?"

"Which old man did you try to get?"

"This one right here."

"Oh, well, he is busy; you can't take him. Here, Tom, get the old man down in the other room and give it to Bob."

Now, Bob thinks he has graduated in "old man," but he hasn't; not yet awhile. By and by he will find that this is a term of high honor, and is applied by the men to the one that they consider the leader in the works. Where he is a mechanic and actively engaged in the management of the shop the term will be applied to the owner. In other cases it will be the superintendent or general manager when he is the active head of the shop. For a man young in years to get to be the "Old Man" of an establishment is a high honor as showing the confidence the men have in him. Some people may object to "my old man" as a way of speaking of one's father, yet it is used very commonly where no disrespect is felt or intended, and usually having the men feel that a certain man is their "Old Man," mechanically speaking, is complimentary to that man, even if not expressed in the most polished way. I feel sorry for the shops that haven't any such "Old Man."

Perhaps some may think it not exactly a compliment to name a rough contraption of iron the "Old Man" also; but, after all, it is not very far from the mark, and, indeed, is rather a compliment, for surely nothing stands firm and holds things steady better than the "Old Man," while it is very accommodating at the same time.

One of the hard-worked words of the trade is "valve." If anything new is produced that in any manner closes a hole yet is readily moved, that seems to be a good name for it, while the pieces may be very dissimilar in appearance and application. Sometimes things are called valves that at first glance seem entirely misnamed as far as any connection with any real valves goes. Why a cutter intended to cut off a rope down at the bottom of an oil well should be called a valve might puzzle some people, but a glance at it would show anyone used to fixing "butterfly valves" a pretty good reason. It not only has a strong resemblance but it shuts off the rope much closer than many "butterfly valves" in a steam line shut off the steam.

I wouldn't imagine that the man who used the term "rimmer" for reamer would need to be either a foreigner or a student of foreign derivations. Bless you, he only wanted to take a little out of the rim of that hole up near the top. Don't you see? he would "rim" it out, and to do that he would use a "rimmer." He has good precedent (as the lawyers are fond of saying) for such a course, for don't he use a "drill" in a "drill" to "drill"? I know some say "an iron bit in a rotary press machine to bore" a hole, but they have not been long enough in the machinist country to read and write the language or to be naturalized.

In the term "valve" it would seem as though we needed some more words, as it is a little indefinite at times. A globe valve is not complete unless it has the piece that rests on the seat which also is a valve, yet it is rather awkward to call for a "valve for a globe valve," although I do not know of any single word to use instead.

It is pretty safe to call almost anything that will hold something a "dog." Any boy that has played with a puppy knows that a dog is good at holding things, and will hold all sorts of things in all sorts of ways. Who would ever think of calling any such sort of thing a "cat"? The very idea would be out of place, and it is this idea of fitness that makes many of these terms stick. While the average man cares very little for the purity of the derivation he certainly admires and "takes to" a term that gives expression to his thought in a terse manner.

More than one mechanical engineer has spent time and thought on the correct naming of the various parts of some new mechanical creation only to find many parts rechristened in the shop. Most men would pick up the right piece if it was spoken of as a "goose neck" and wouldn't expect it to be a big, solid, chunky piece, either.

Very few makers list a "rat-tail" file, yet the toolman doesn't look among the squares or the slim tapers when one is called for, neither does he pass out a 14-inch round. That would mean too big a rat.

And speaking of files, how few men call them by the names as listed? How many will distinguish between a "flat" file and a "hand" file? Aren't they both flat, and do you think we file with our feet?

"Flywheel" seems very appropriate, in view of the results between the time the pieces leave the engine and the time they reach the ground sometimes; besides, their regular gait is more than walking or running. It comes nearer to flying than to any other common gait.

A shopman generally knows whether a mechanic wrote a given catalog or not. When he finds it freely sprinkled with such words and expressions as "infinitely," "inestimable value," "of incalculable importance," "beyond comparison," "absolutely perfect," "unapproachable," "meets with unqualified approval," and the like, he begins to wonder whether the printer got some description of an ideal heroine from the latest novel mixed in by accident, or whether he has gotten hold of a promoter's description of what the new silver mine would be if only money enough was forthcoming to develop it.

When he finds these terms are applied to a machine for mixing mud for a brick machine, or something of that kind, he wonders if the machine will really stand up alone. Such terms have no meaning as applied to things in a machine shop, and are never found among our *home-made* names.

After being used to the gorgeous trimmings usually found in advertisements, it may take considerable nerve to write up a description of anything and keep it down to solid *undisputed* facts, because there are very few, even in applied mechanics, that all think alike on; but it is usually well to have a thorough mechanic look over the technical words and terms if the advertisement is intended for those skilled in the business.

It might puzzle an outsider to know why the side of a piece is "faced" while the outside is "turned off," or to know why we "drill" a hole made in a solid piece and then "bore" it to size with a "tool." He might not even see that a drill or a mandrel or even a pair of calipers is not a "tool" to a lathe hand when talking of work. Knowing that chisels are cutting tools he cannot see any reason for a titter from the cub when he calls a side tool by that name.

He sees a machinist "run" his carriage back and forth without knowing why *walk* would not better suit the speed. Should he be of an observing nature, there will be many more odd expressions he will hear and it may be wise to go a little slow in concluding that these terms are used only through ignorance of more correct language in trying to give an example of correct use.

In Rome do as Romans do, if you want them to think you belong there and are used to the customs of the place. Otherwise they might think it a little presumptuous in a stranger to the needs and customs of a place to try to improve on what they considered best for themselves.

A gentleman was getting some work done and was around the shop among the men seeing that everything was as he desired. For once the men did not seem worried or nervous, and would work along in their usual way just as though he wasn't around. They seemed to understand his talk first rate, and soon had it worked out to their own satisfaction that he was a machinist, although he didn't look it. He was at the time superintendent of a large oil company and had a quiet, pleasant way of speaking that was very taking. Inquiry showed that he was a machinist and had spent several years in the shops. That had been years before, yet he had some of the earmarks left and the boys enjoyed talking to him. After they had gotten quite well acquainted with him, some of them were quite startled to find out that he was among other things a preacher. In trying to think back some of them were afraid they had not talked the language suited to that calling to him. But he was both a scholar and a gentleman.

W. OSBORNE.

A Swedish Worm Spur and Spiral Gear Cutting Machine.

At page 175, Vol. 21, we published an article by Professor Sweet, describing a machine by the Atlas Company, of Stockholm, Sweden, for cutting spur and worm gear wheels, and again at page 1236, Vol. 24, we gave general illustrations of the same machine as arranged for various classes of work. Inasmuch as one of these machines has recently been imported by the Christensen Engineering Company, of Milwaukee, for cutting large spiral gears (spur gears with spiral teeth) because they could find nothing in the home market adequate to their needs, we doubt not that a fuller description than we have heretofore been able to give of the machine, as arranged for cutting spiral teeth, will be of interest to our readers.

The action of the mechanism will be clear from the illustrations and the following description which are supplied to us by the makers:

The pulley *h*,* which is driven by a belt from the countershaft, is connected to pinion *a* by an adjustable friction clutch *b*, so that when the pawl *e* is released from the stop cam on disk *f* (when the cutter is near its highest position on the upstroke) the shaft *g* makes one revolution and thereby, in the common manner, turns the worm shaft *i*, the table and the wheel to be cut, one tooth according to the change gears *E* between shaft *g* and *i*.

The pawl *e* is placed in the wheel a_1, which is fastened on shaft *g*, and is released from the stop cam by means of a conical socket g_1; this socket is, by means of arms and straps, connected to the reversing mechanism for the feed; the disk *f*, with the stop cam, is secured to wheel *l* so that shaft *g* runs loose in its hub. When cutting straight teeth the wheel *l* and disk *f* are secured to the stand by pin *p*, but in cutting spiral gears this pin is pulled out and change gears inserted between shaft *m* and pinion *r*, in order to turn wheel *l* with disk *f*, change gears *E*, worm shaft *i*, the table and wheel to be cut according to the angle of spiral.

The pawl *e* is, by means of the friction pulley, always forced against the stop cam, so that the table and wheel to be cut turn in *one* direction when the cutter is fed down—*i. e.*, when the cut is taken—and in the opposite direction when the cutter returns. The indexing is done in the same manner as in cutting straight teeth. Of course both right- and left-hand spirals can be cut.

The cutter head can be set in *any* angle; the change gear at *F* must be selected according to the *angle of spiral* and *pitch of teeth* to be cut, but has nothing to do with the *number of teeth* or *pitch of spiral*. Thus it may be understood that the same change gear will do for wheels with *any* number of teeth, provided the wheels have the same circular or diametral pitch and the same angle of spiral. This is, of course, of great value when a pair of wheels which must mesh in each other are to be cut.

The following formula is for the change gear at *F*:

Let T_1 = circular pitch in mm.,
v = angle of spiral,
$K\,K$ = diameters of driven gears as per small illustration,
$k\,k$ = diameters of driving gears as per small illustration,

then $$\frac{K \times K}{k \times k} = \frac{T_1}{15 \times \tan.\ v}$$

If $T_1 = 32$ mm.

and $v = 25$ degrees,

then $\tan.\ v = .466$

and $$\frac{K \times K}{k \times k} = \frac{32}{15 \times .466}$$

$$= \frac{32}{7}$$

$$= \frac{60 - 80 \text{ driven wheels}}{35 - 30 \text{ driving wheels}}$$

If Brown & Sharpe standard cutters are to be used, the formulas are as follows:

* This pulley is within the housing and is driven by a belt running through the two round holes shown in the plan.—ED.

Let P = diametral pitch, Brown & Sharpe standard,

P_1 = pitch in inches on the pitch circle

$$= \frac{\pi}{P}$$

D = diameter of pitch circle in wheel with straight teeth.

$$D = \frac{N}{P}$$

N = number of teeth to be cut,

T_1 = pitch in inches on the pitch circle, in wheel with spiral teeth

$$= \frac{\pi}{P \times \cos. v} = \frac{P_1}{\cos. v}$$

D_1 = diameter of pitch circle in wheel with spiral teeth

$$D_1 = \frac{N \times T_1}{\pi} = \frac{N \times P_1}{\pi \times \cos. v} = \frac{N}{P \times \cos. v}$$

v = angle of spiral tooth to the shaft.

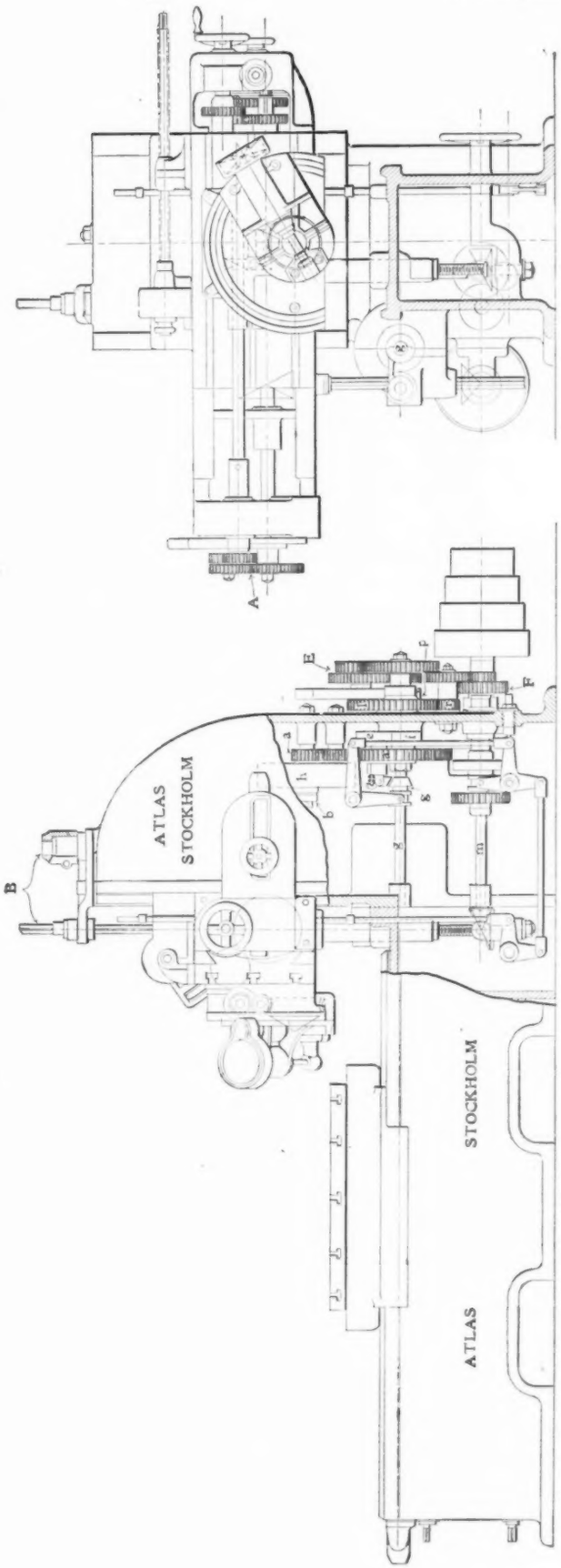
$$\frac{K}{k} = \frac{8 \times T_1}{5 \times \text{tang.} v} = \frac{8 \times P_1}{5 \times \sin. v} = \frac{8 \times \pi}{5 \times P \times \sin. v}$$

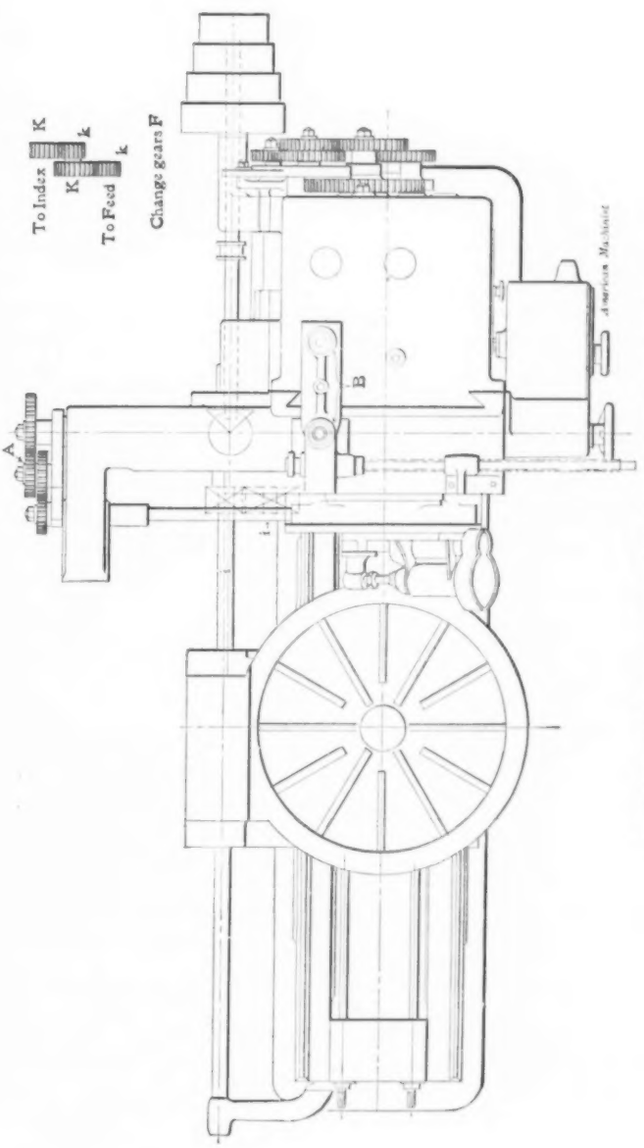
For cutting spur wheels with straight teeth, internal and worm wheels the machine is supplied with suitable tables for setting the change gear. For cutting spur gears, as above mentioned, the change gears for indexing are placed at E. For worm wheels the change gear for number of teeth are placed at A, and for the pitch of thread at B.

The machine is made in two sizes having the following leading dimensions:

Diameter of table—600 and 840 mm.

Horizontal distance between center of cutter spindle and center of table—0 to 1,000, and 140 to 1,300 mm. for worm





SWEDISH WORM SPUR AND SPIRAL GEAR CUTTING MACHINE.

wheels, common spur and internal gears; for spiral gears this distance is 140 mm. less.

Vertical distance between table and center of cutter spindle—0 to 600 mm. for both sizes.

Length of feed of cutter spindle in cutting worm wheels—580 mm.

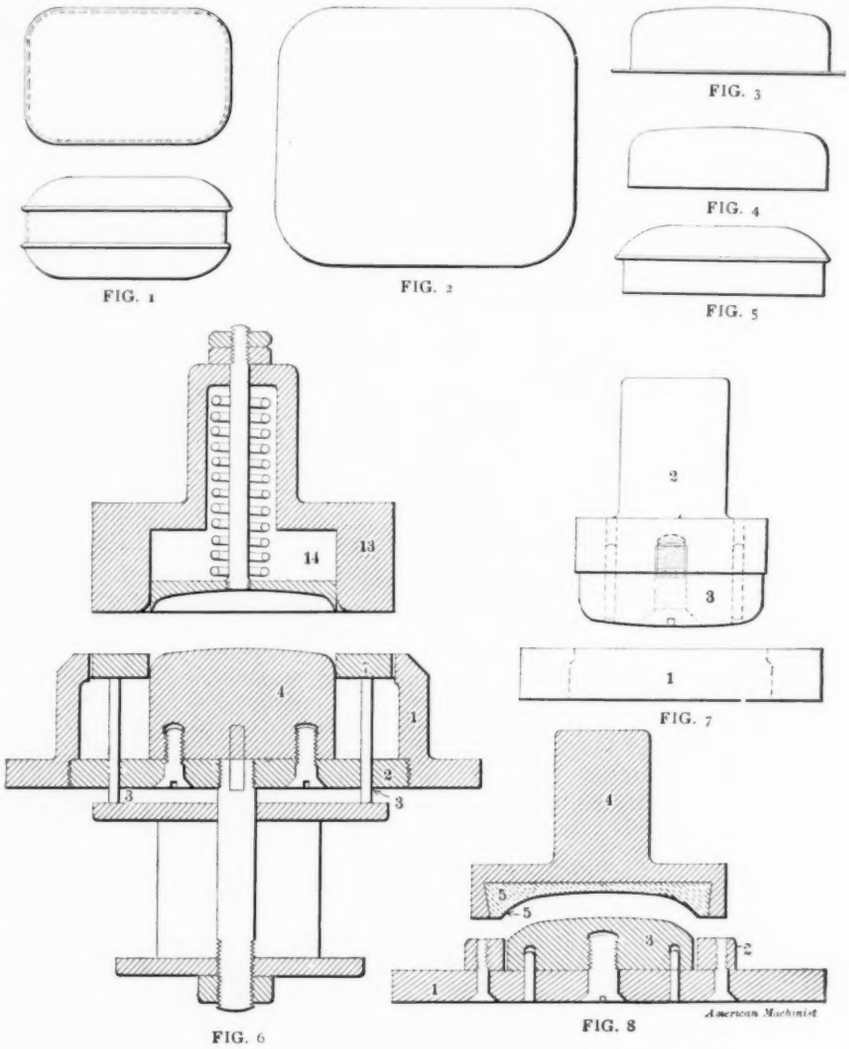
Combination Dies for An Aluminum Box.

BY H. ROBINSON.

Fig. 1 shows an aluminum soap-box, made in halves, both parts being alike, except that the outer part is one thickness of the metal larger all around, to allow it to fit over the bottom or inner part. The box measures approximately, over all, 3⅞x2½x2 inches. Each half is made complete in three operations. The first operation consists of cutting out the proper blank, Fig. 2, and drawing it up to the shape shown in Fig. 3. The trimming of the end or flange, as shown in Fig. 4, forms the second operation. To give it the proper and finished shape, and sizing it to make it an inner or outer part, top or bottom, Fig. 5, constitutes the third and last operation. The complete piece, of either half, is made in three dies. One combination die and punch, Fig. 6, blanks and draws for both halves of the box, as per Figs. 2 and 3. A trimming die, Fig. 7, trims the ends, as shown in Fig. 4. Two forming dies, Fig. 8, are used for forming and sizing, as shown in Fig. 5, one for the outer and the other for the inner half.

In Fig. 6 is a forged die 1 of tool and machine steel, 2½ inches deep, faced top and bottom, filed out at the cutting edge to fit the templet of the blank, Fig. 2, allowing one degree clearance on the inside of the cutting edge, recessed and threaded at the bottom ⅝ inch deep to receive a round, turned and threaded disk 2. This disk is large enough in diameter to cover all of the die part, with a ¾-inch tapped hole in the center, and eight ¼-inch holes 3 in a circle drilled through it. A machine-steel forming block 4, 1¾ inches high, the periphery of which is equal to the inside of the inner half of the box, well rounded and finished smooth on the top and corners, is fastened in the center of the die to the bottom plate 2 with screws and dowel pins. A ring 7, fitting freely on the forming block 4 and about 1-32 inch smaller on each outer side all around than the inner part of the cutting edge of the die, is faced and finished smoothly all over, especially so on top or face. Eight ¼-inch Stubs steel hardened pins 8, squared at both ends, fit freely in the holes 3. A stud 9 is screwed into the center of the bottom plate, two large washers fitting loosely on it with a piece of rubber between them and a nut on the end of the stud which is threaded long enough for adjustment for holding the blank fast while being drawn over the forming block, and preventing its wrinkling.

The outside of the body of the punch is fitted nicely to the cutting edge of the die and milled out, 14, on the inside to fit nicely over the forming block in the die plus the thickness of the aluminum of the box all around, the inside corners rounded and finished smooth, also the face or bottom of the punch. The shank is bored out to within ⅜ inch of the top, with a ⅝-inch hole through the center of the top. A cupped plunger or follower 15 fits loosely inside the punch, with a stem screwed into it and a brass spring inside the shank of the punch.



COMBINATION DIES FOR ALUMINUM SOAP BOX.

In Fig. 7, the punch and die for trimming is a tool-steel plate 1 finished to fit outside of the formed-up cover, Fig. 3, into which it centers up to the flange. The punch 2 is fitted nicely to the die, a block of soft steel or cast iron, 3, the same size and shape as the inside of the cover, Fig. 3, is fastened to the bottom of the punch, leaving an equal margin all around, which should just equal the thickness of the aluminum, to guide the cover in the die to its proper position and trim it as per Fig 4.

The bottom plate of the finishing or forming die, Fig. 8, two of which are made, has another plate upon it cut out inside to fit snugly outside of the cover, Fig. 4. A block 3 the size of the inside of the cover, and finished on top to the proper finished space of the box and the required hight, is fastened to the bottom plate 1, leaving just enough room all around it and between it and the inside of plate 2 for the thickness of the aluminum for the drawn-up cover to fit into. The other die is made as Fig. 8, except that it is one thickness of the metal larger so as to make one cover larger and one smaller to fit over each other. The punch *A*, to form the top of the covers in both of the forming dies, is made of machine steel or cast iron, milled out on the inside to within ⅜ inch of the top and ¾ inch deep and filled with soft babbitt or lead 5, and formed out to the finished shape of the top of the box and eased out at the ends on the inside to allow the metal of the cover to spread and form around it a projection or bead by the metal being forced from the top over its sides. This completes the making of the box, Fig. 1.

Progress in the Iron and Steel Industries.

The importance and magnitude of the iron and steel industries justify a few extracts from the Census Bulletin of the Twelfth Census devoted to those industries:

	Year.	Total number of Wage-earners.
Total	1900	222,607
	1890	171,181
	1880	140,798
Blast furnaces	1900	39,358
	1890	33,415
	1880	41,695
Rolling mills and steel wks.	1900	183,023
	1890	137,295
	1880	96,164
Forges and bloomeries	1900	226
	1890	471
	1880	2,939

TABLE I — GROWTH OF IRON AND STEEL INDUSTRIES AS SHOWN BY THE NUMBER OF WORKMEN EMPLOYED.

The reports show a capital of $590,530,484 invested in the iron and steel industry in the 669 active establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The value of the products is returned at $804,034,918, to produce which involved an outlay of $11,741,788 for salaries of officials, clerks, etc.; $120,836,338 for wages; $32,274,100 for miscellaneous expenses, including rent, taxes, etc.; and $522,431,701 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the iron and steel industry during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the works. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

The accompanying tables exhibit the most salient features of the growth of these industries. All tons are gross tons of 2,240 pounds.

The production of pig iron with anthracite coal and coke mixed for fuel increased slightly in 1900, compared with 1890. The great increase, however, was in pig iron made with bituminous fuel; that is, with coke alone or with coke and bituminous coal mixed. A marked decline is shown in the production of charcoal pig iron in 1900, compared with 1890; also in the production of pig iron with anthracite coal alone, the falling off in iron made with the latter fuel being especially heavy compared with both 1890 and 1880. For the first time in the census tables, pig iron made with a mixture of charcoal and coke as fuel appears.

The increase in 1900 in the production of pig iron made with coke and bituminous coal, compared with 1890, was 5,987,953 tons, or 95.6 per cent., and compared with 1880 it was 10,898,860 tons, or 804.4 per cent. In 1900, compared with 1890, the increase in the production of pig iron with mixed anthracite coal and coke amounted to only 105,606 tons, or 6.2 per cent., while compared with 1880 the increase was 1,157,973 tons, or 181.5 per cent.

The production of charcoal pig iron in 1900 fell off 289,925 tons compared with 1890, or 48.9 per cent., and compared with 1880 it declined 85,110 tons, or 21.9 per cent. The use of anthracite coal alone for fuel in the manufacture of pig iron is gradually being abandoned. Compared with 1890, the production with this fuel decreased in 1900 to the extent of 240,577 tons, or 85.4 per cent. Compared with 1880, the decrease was 948,393 tons, or 95.4 per cent. In 1900 only two establishments reported the manufacture of pig iron with anthracite coal alone.

The pig iron exported by blast-furnace establishments in 1900 amounted to 166,625 tons, valued at $1,865,484, or an average value per ton of $11.19. In the figures given above, the exports of pig iron by commission houses, etc., are not included.

As has been stated heretofore, the rapid growth of the pig-iron industry in the United States during the past twenty years has been due almost entirely to the increased use of coke as a blast-furnace fuel. In 1880, when the total production of all kinds of pig iron amounted to 3,375,912 tons, almost one-half of the quantity made in the whole country was produced with anthracite coal alone or with anthracite coal and coke mixed, the production with this fuel amounting to 1,632,277 tons. In the same year, with coke alone or with bituminous coal and coke mixed, the production was 1,354,958 tons, or 277,319 tons less than the combined output with anthracite alone and with anthracite coal and coke. In 1890 the use of anthracite coal alone as a fuel had greatly declined, while the use of anthracite coal and coke had increased considerably, the combined production of pig iron with these two mineral fuels amounting to 1,985,828 tons. The production of pig iron with bituminous fuel, however, in the year named showed a phenomenal growth as compared with 1880, the output amounting to 6,265,865 tons, the difference in tonnage between the two classes of pig iron being 4,280,037 tons.

In 1900 the use of anthracite coal alone in blast furnaces had almost entirely ceased, the total production of pig iron with this fuel amounting to only 45,857 tons. The use of anthracite coal and coke mixed increased but slightly as compared with ten years ago, the pig iron produced with this fuel in 1900 exceeding the pro-

	Year.	Total Fuel Used.	
		Tons.	Cost.
Total	1900	. . . . .	$66,652,344
	1890	. . . . .	55,561,749
	1880	. . . . .	35,969,873
Anthracite coal and culm	1900	1,830,582	3,518,113
	1890	2,655,280	6,654,420
	1880	2,966,517	9,889,037
Bituminous coal and slack	1900	11,777,834	15,783,887
	1890	5,110,187	10,426,030
	1880	5,052,727	12,610,440
Coke	1900	15,525,103	40,991,400
	1890	8,600,347	28,752,972
	1880	2,033,532	8,743,382
Charcoal *	1900	35,209,887	2,101,787
	1890	74,499,202	5,037,175
	1880	69,592,091	4,726,114
Oil, used for fuel †	1900	1,302,615	1,158,748
	1890	1,859,138	1,124,206
	1880	853	900
Natural gas	1900	. . . . .	3,098,409
	1890	. . . . .	3,566,946
	1880	. . . . .	. . . . .

* Bushels. † Barrels.

TABLE II — GROWTH OF THE IRON AND STEEL INDUSTRIES AS SHOWN BY THE AMOUNT OF FUEL USED.

duction of 1890 by only 105,606 tons. The use of bituminous fuel, however, again showed a wonderful growth, the production of 1900 exceeding that of 1890 by 5,987,953 tons, or 95.6 per cent. Comparing the combined production of anthracite and mixed anthracite and coke pig iron in 1900 with the production of bituminous pig iron alone in that year, it is found that the latter exceeded the former by 10,411,961 tons. When it is recalled that only twenty years ago the production of pig iron with anthracite coal and with anthracite and coke mixed exceeded the production of bituminous iron by 277,319 tons, the growth of this branch of the pig-iron industry becomes more apparent.

As shown by the details given in the table, Pennsylvania reported in 1900 considerably over one-half of the total capital invested by the whole country in the manufacture of steel and of rolled iron and steel; employed over one-half of the total number of wage-earners; paid these wage-earners more than one-half of the total wages reported; paid for materials used considerably over one-half the total cost reported, and, as already stated, manufactured iron and steel products greatly in excess of the value reported by all the other iron and steel manufacturing States in the Union. While, as has been shown heretofore, this State is far in the lead of all other States as a producer of pig iron, its pre-eminence as a manufacturer of steel and of rolled iron and steel is even more pronounced. The growth of this branch of its iron and steel industry during the decade from 1890 to 1900 can be better appreciated, perhaps, by calling attention to the fact that the value of its steel and rolled iron and steel products in 1900 exceeded by $727,302 the total value reported for the whole country (including Pennsylvania) in 1890, the figures being as follows: Total value of products reported in 1890 by all rolling mills and steel works, $331,860,872; value of similar products reported by Pennsylvania only in 1900, $332,588,174; excess of value reported by Pennsylvania in 1900 over the value reported for the whole country (including Pennsylvania) in 1890, 727,302.

The increasing use of iron and steel in late years in the construction of large office buildings, bridges, steel cars, etc., is forcibly shown by comparing the production of structural shapes in 1900 with 1890 and 1880. In 1900 the total production of iron, Bessemer steel, and open-hearth steel material for structural purposes was 856,983 tons, against 276,355 tons in 1890, an increase of 580,628 tons, or 210.1 per cent, and 87,006 tons in 1880, an increase of 769,977 tons, or 885 per cent. Steel has largely supplanted iron for work of this character since 1880, when almost all the structural shapes reported were made of the latter metal. As shown in the table, the falling off in 1900 in the production of iron structural shapes as compared with 1890 amounted to 95,701 tons, or 77.9 per cent., and as compared with 1880 to 59,347 tons, or 68.7 per cent., the figures for 1890 showing a growth as compared with 1880. Bessemer structural shapes show an increase in 1900 as compared with 1890 of 178,360 tons, or 208.8 per cent., and as compared with 1880 of 263,303 tons. Open-hearth structural shapes increased in 1900 over 1890 by 497,969 tons, or 731 per cent., and over 1880 by 566,021 tons.

The production of open-hearth steel ingots and castings in the United States in the census year 1900 by the acid and basic processes amounted to 3,044,356 tons, as compared with 480,035 tons in 1890 and 75,269 tons in 1880, an increase in 1900 over 1890 of 2,564,321 tons, or 534.2 per cent., and over 1880 of 2,969,087 tons, or 3,944.6 per cent.

	Year.	Total.	
		Tons.	Cost.
Total	1900	34,649,109	$76,089,080
	1890	21,725,698	74,254,942
	1880	10,029,378	39,974,700
Iron ore	1900	25,722,000	67,257,063
	1890	15,558,412	66,971,256
	1880	6,883,667	36,516,697
Mill cinder, scrap, etc.	1900	1,600,313	3,772,385
	1890	1,145,599	3,086,808
	1880	316,114	910,667
Fluxing material	1900	7,326,706	5,059,632
	1890	5,021,687	4,196,878
	1880	2,829,597	2,547,336

TABLE III—GROWTH OF THE IRON AND STEEL INDUSTRIES AS SHOWN BY THE MATERIALS USED.

Classes.	Tons.			Per cent. of Increase.	
	1900.	1890.	1880.	1890 to 1900.	1880 to 1890
Total	29,507,860	16,264,478	6,486,733	81.4	150.7
Products of blast furnaces	14,452,234	8,845,185	3,375,912	63.4	162.0
Products of rolling mills and steel works	15,040,129	7,388,244	3,046,038	103.6	142.6
Products of forges and bloomeries	15,497	31,049	64,783	*50.1	*52.1

* Decrease.

TABLE IV—GROWTH OF THE IRON AND STEEL INDUSTRIES AS SHOWN BY THE OUTPUT.

Punching Brass Clock Gears—Movable Stripping Devices.

BY WM. DORAN.

We were manufacturing an automatic time indicator and had been buying sheet brass blanks, for making the gears, from a firm in New England. At length the firm decided to produce the gears themselves from the sheet, and the punch and die here shown were made to produce them.

The gear shown in Fig. 1 was produced complete from ⅛ inch thick sheet brass. Holes were required to be punched at *A*, *B* and *C*, five sections *D* cut away, the center hole punched and the teeth cut. The gear was required to be perfectly true with the center hole and to balance evenly.

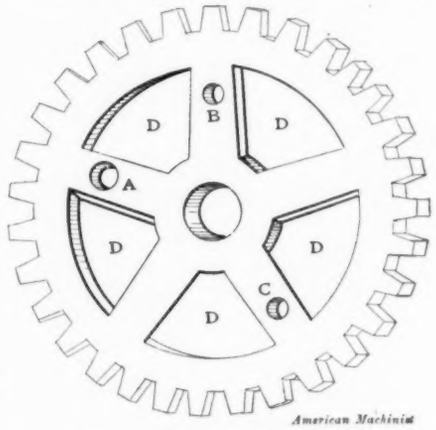


FIG. 1. THE GEAR TO BE MADE.

A cross-section of the punch and die is shown in Fig. 2, with a plan of the die in Fig. 3. Three successive operations produce the gear. The three holes *A*, *B* and *C* and the large center hole are pierced in the dies at the first stroke, the sections *D* are punched out at the second, and at the

third stroke a finished gear is cut out. Hardened and ground bushings are used for the dies *h*, *d* and *m*, to allow of easy repairing.

It is in the die *X X* that unusual conditions are met. This die, used for punching the sections *D*, is made in two parts, although this might not appear necessary to some. The work to be done, however, in this die was of such a character that satisfactory results would have been impossible with a solid die.

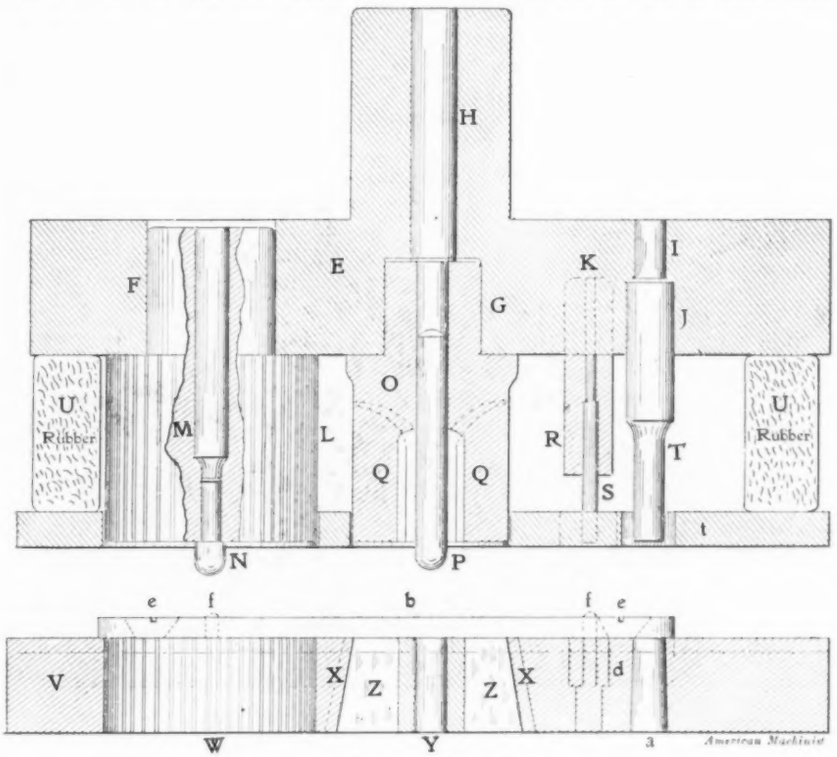


FIG. 2. PUNCH AND DIE FOR BRASS GEARS.

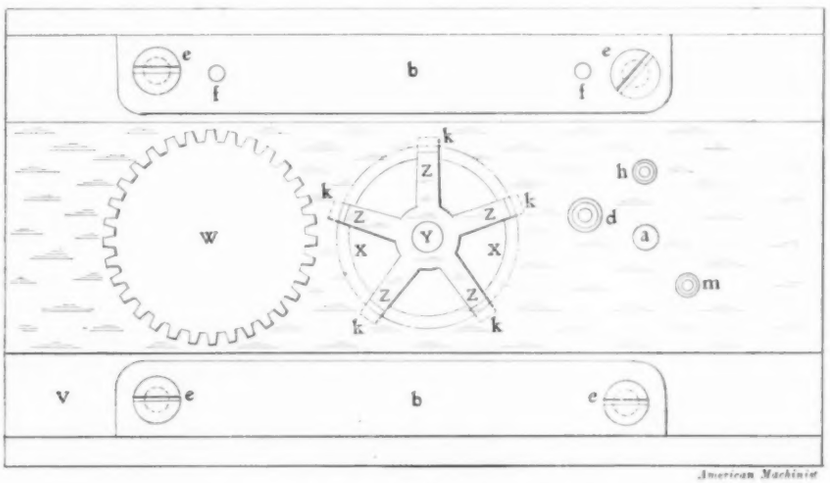


FIG. 3. PLAN OF DIE.

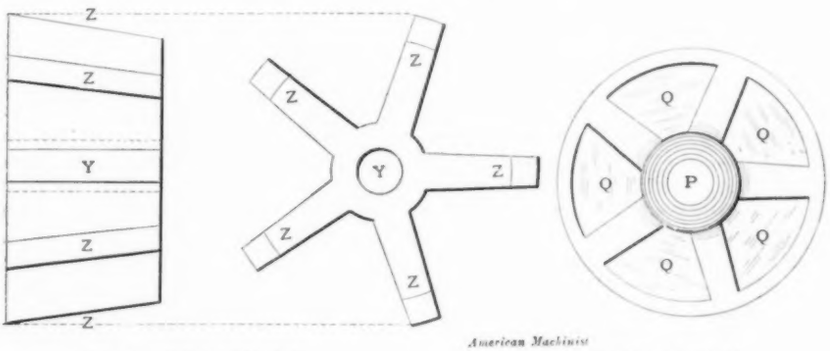


FIG. 4. SPIDER FOR DIE.

FIG. 5. PLAN OF PUNCH.

The "spider" used in this die is shown as located and fastened in position in Fig. 3, and in detail in Fig. 4. As shown, there are five arms *Z* and a hole at *Y*. The outsides of the wings are turned taper, large at the back and maller at the cutting face. The spider was left large all over and hardened and drawn to a light straw. It was then chucked and the hole *Y* was lapped to the size of the hole in the gear, after which the spider was forced on a mandrel and ground all over to size, which was, to say the least, a very nice job. The portion *X X* in the die plate was bored taper, and five shallow channels *K* were cut into its walls, as locating seats for the wings *Z* of the spider.

The blanking die *W*, in which the gear teeth are cut and the finished piece is produced, was finished by reversing the usual method; that is, instead of shearing the punch through the die, the die was broached by the punch. As will be seen in Fig. 2, this punch is finished with a stem *F* to fit a hole in the machine steel holder *E*, and has a hole straight through it for the pilot pin *N*. The teeth in the punch were milled and finished in the same manner as a gear would be, getting as smooth a finish as possible. The punch was hardened and drawn slightly, after which the face was ground and stoned keen. The die *W* was then finished by using the punch as a broach. The die plate *V* was hardened and ground. Then the punch *L* was reannealed and sheared into and through the die. Thus a perfect fit was attained. The punch was left soft.

The center piercing punch *T* is in one piece and is let into a counterbored seat *J* in the holder. The other three piercing punches for the holes *A*, *B* and *C*, Fig. 1, are of drill rod, and are located in strong supplementary holders, as shown at *R*, *S* and *K*.

The punch (or punches) for cutting the sections *D*, in Fig. 1, is shown at *Q Q*, in Fig. 2, and a plan or face view of it in Fig. 5. *P* is the pilot pin. The punches *Q* form parts of the solid piece *O* and were not hardened, as, if they had been, the resulting distortion would have made a fit within the die *X X* and the spider *Z* impossible. As it was, by shearing the sections *Q* into the die and leaving them soft, no difficulty was experienced in getting a close fit at all points.

The only part requiring further description is the stripper, which is of unusual construction. As shown in Fig. 2, it is located on the punch, or "male" die. It comprises a flat mild steel plate *T*, fitting around the punches proper, two blocks of hard-spring rubber *U U*, one located between the stripping plate and the punch-holder face at each end, and four studs of the usual construction, not shown. One of these studs is located at each of the four corners, with the heads let into coun-

terbored hole in the back of the holder and the ends screwed into the stripping plate. No other springs were required, as the rubber blocks answered for that purpose.

Although a great many diemakers claim that spring strippers located on the punch should not be used where a stationary stripper can be located on the die, still there is a large variety of work for the production of which a movable stripper must be used if accurate results are to be obtained.

It is well known that punching or perforating dies having stationary strippers will distort the plates or articles punched by them, and often to such an extent as to require subsequent straightening. Thus where accurate parts, such as are used for clocks, electrical instruments, etc., are produced in gang dies, the distortion of the metal as it is worked upon progressively by the various punches, will, when stationary strippers are used, prevent the production of satisfactory work. On the other hand, where movable strippers (any of the various types I mean, and not merely the one shown here) are used, a clear space is left between the punches and dies, enabling the operator to manipulate and observe his work quickly and accurately. The stripper comes down on the strip of stock first, straightening and clamping it before the punches enter, while the pilot pins locate for the various operations positively. The metal is held under pressure while the punching and stripping are being done, and by this means the work comes out perfectly straight and true. Where a number of small perforating punches are required, they may be made with the use of the movable stripper much shorter than a stationary stripper would permit. At the same time a smaller hole, in proportion to the thickness of the stock, may be pierced because of the close support which the movable stripper (when well fitted) gives to the punches up to the point where they enter the stock.

Milling Worms on the Planer.

The attachment which converts a planer into a milling machine has been shown in our pages before, but the half-tone shows an interesting and profitable employment of it which warrants us in again bringing it to the attention of our readers. The story of it is told very completely by the half-tone, and if any additional information is wanted it is supplied by the drawing, Fig. 2, which shows the mounting and feeding of the worm in detail. The worm wheel at the right in the half-tone, driven at a very slow speed by the worm and the reducing train of gears, is shouldered between two standards and has two feathers which fit in splines in the master screw and cause its rotation. The pitch of this screw is the same as that of the screw or worm to be cut. The flat pin or key *a* fits into a groove of the thread and constitutes the nut by which the screw is fed along as it rotates. It is held up by key *b*, and when this is withdrawn *a* drops and the screw may be moved along endwise as required. The blank to be cut slips on to the inserted stem of the screw, with a sleeve outside which fits the other standard and a nut which holds all together. The worms shown have a double thread. When one of the thread grooves is cut pin *a* is dropped and the screw is slid along for this pin to be inserted in the next groove, which is all the change required. The pulley driving the screw may run continuously, the knurled screw *d* providing the means for connecting it to drive the shaft upon which it runs or to disconnect it as required. The frame is of course bolted upon the planer platen obliquely to correspond with the angle of the screw thread, and the platen is firmly secured to the bed. The Farwell milling attachment here shown in operation is made by The Adams Company, Dubuque, Iowa.

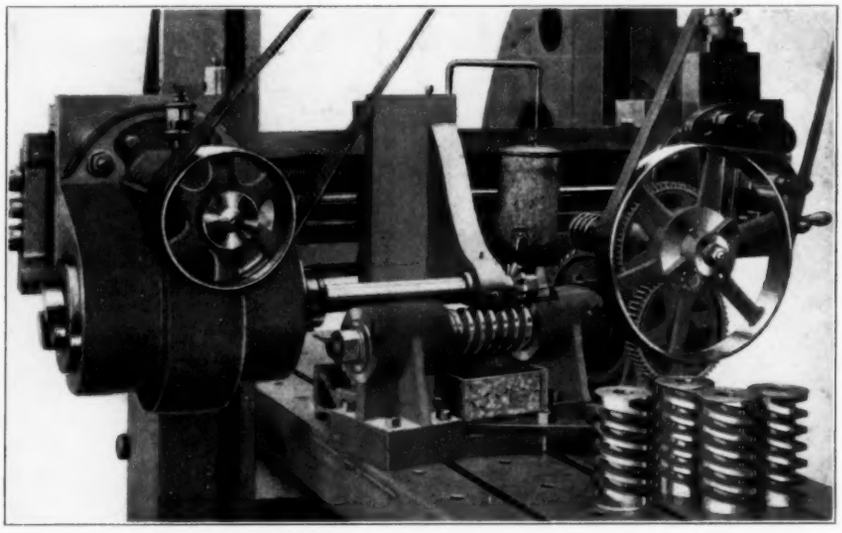


FIG. 1. MILLING WORMS ON THE PLANER.

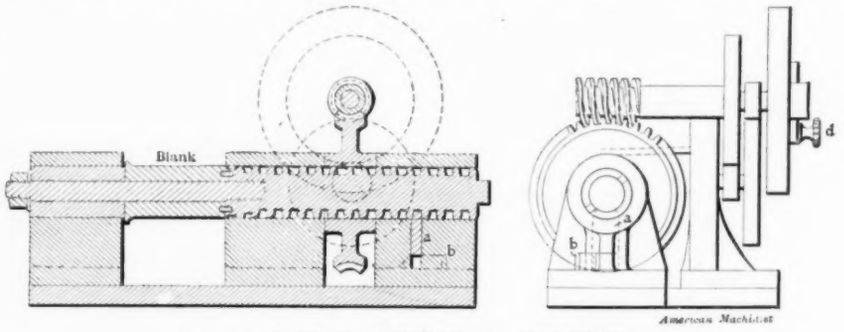


FIG. 2. DETAILS OF WORM MILLING ATTACHMENT.

Ownership of Public Necessities.

It is so common to see trade and technical journals standing up for the powerful interests they represent, right or wrong, refusing, in fact, to perceive that there can be two sides to any question in which their special interests are involved, that it is decidedly refreshing to find in the *Railway and Engineering Review* the following editorial article, entitled as above. Our contemporary says:

"If, as is not improbable, the prospective settlement of the anthracite coal strike shall prove to be the beginning of the solution of the question as to where the rights of private ownership become secondary to the rights of the people whenever public utilities or necessities are concerned, then the privations endured by the miners, the losses incurred by the operators and the inconveniences borne by the people will not have been altogether useless. It is conceded that as between individuals, the right to determine the disposition of property is inviolable, but it must also be admitted that whenever such disposition transgresses public welfare this prerogative must be modified, if, indeed, not altogether abrogated. In a primitive state where social obligations are practically wanting, a man may do what he will with his own without let or hindrance. In such a condition, and in such a condition only, are men independent. The moment social relation and interchange begin, that moment reciprocal obligation commences. The development and progress of these relations involve a corresponding diminution of individual authority, and it is easily conceivable that,

extended to its ultimate, the direct antithesis of primitive conditions logically obtains, and from barbarism we have come to socialism, the one as objectionable as the other. Where is the happy medium? is the problem, and to its solution the minds of students at this time naturally are turned.

"To substitute the concrete for the abstract, the present anthracite agitation affords an excellent object lesson. As society is organized in this country, it is impossible for men to be independent on the question of fuel. Although there is an abundance of coal in the country, it has come under the control of a comparatively few individuals. Originally it was owned by the people in their associate or governmental capacity, but it has been surrendered for a stipulated consideration to the control of those who are now in possession. The whole trouble has arisen from the lack of a distinct understanding as to the obligations that necessarily follow such transfer. As a matter of fact, the coal itself was not and could not be transferred; all that was involved in the transaction was the privilege to mine and distribute it. It was impossible that the individual user of coal in the country should do his own mining. He is entitled to so much of the supply as he requires for his use, but because of attendant social conditions he must employ someone to get it out and deliver it in the form and place suited for his purpose. The right to do this is all that the mine owners obtained when they purchased the property. Should they attempt to close down the mines and stop the supply of coal under the plea that as belonging to them they had the right to keep their property, they would soon discover their mistake. It is at this point that individual rights become subservient to public welfare. The obligations implied in the purchase of the control of the property must be fulfilled.

"If our premises are correct, the cost to the consumer of this commodity should be such a sum as will afford adequate return for the labor involved to all concerned. The mine owner is entitled to his share because of invested capital and supervisory employment; the miner to his share for the labor in getting out the coal; the owner of transportation facilities to his share for delivering it at the place of consumption, and each of these proportions because of the public character of the article in question is properly the subject of public concern and adjudication. This is why such an exigency as at present exists. The government has a right to determine what shall be done, and it is at least debatable if the government is not bound to see that interruptions of the supply of this public necessity shall not be allowed to seriously affect the people, even to the extent of taking temporary possession of the property. It will be remembered that on a certain occasion when a railroad in Iowa temporarily abandoned service on one of its branches because of long-continued and severe snowstorms making the cost of operation greatly in excess of its possible earnings, the people located on the line in their distress appealed to the Governor of the State for aid. He in turn requested the road to resume operations, setting forth the necessities of the people located thereon, but the railroad company declined to comply with his suggestion. The answer of the Governor was vigorous and to the point. He said, 'If you do not open that line within twenty-four hours, I will,' and the line was opened.

"It should be understood, however, that all of the obligations in connection with this question does not rest upon the operators. The miners, although in less degree, just as surely have their responsibilities to the public. The right of the individual to dig his own coal has been relegated to them, and in accepting the employment they tacitly agree to supply the need. Here, again, the question is not one of individual preference, but of public necessity, and the miner has no more right to inflict a hardship upon the public by refusing to pursue his occupation than has the operator to permit the coal to be mined. Such a menace to public interests cannot be admitted as inherent to any private or personal occupation. There can be no doubt but that the miner has the same right to concentrate and augment his power through the medium of combination as has the operator, but when in the employment of the force resulting from such combination the supply of a necessary commodity is affected, the superior right of the public must control.

"It is just possible that the operators have mistakenly exercised themselves in an attempt to control the price at which this public commodity shall be delivered to the consumers. As stated in the outset, they are entitled to a fair return for the capital invested and for their own work in handling the business. Under the American policy they are permitted in the first instance to determine what this shall be, and the people will accept their conclusions up to the point, and often b yond the point, where it becomes excessive and burdensome. They have, however, gone further than this and elected to decide what compensation the miner shall receive for his part of the work, and thus determine what is the ultimate cost to the consumer. Herein lies an opportunity for a grave error. Suppose, in the first place, the operator was to charge for use of his capital, his brains and his time, only such an amount as he would be able to justify before any competent tribunal, and then add to such a sum whatever may be demanded by the miner for his work, what would happen? Certainly coal would at the outset cost the consumer more than ordinarily is the case; but if it could be demonstrated that the extra cost was on the one hand excessive and on the other more than the miner was entitled to, it would not be long before that part of the total cost would be readjusted. It certainly is indisputable that the miner has the same right to determine what he shall receive for himself as has the operator for himself, and it is more than questionable that because of the public nature of the employment that the public has the right to decide in both cases. The inauguration of such a policy would no doubt upset present values, but that is a minor consideration. Public utility must be served regardless of individual convenience or profit.

"It is easy to perceive that this line of argument points to permanent courts of arbitration to which all such questions shall be referred, and that it includes all quasi-public utilities. It is just for this reason that the subject is treated in these columns. Railroad operation comes in this category, and if the interruptions to traffic which are constantly occurring because of disputes between the so-called employer and employee can be prevented by reference to such a court, there is ample reason for its establishment. To come back to the original proposition, a man may do what he will with his own, but there are a good many things which are not his own, and among them is the coal which is in the earth, and the opportunity for transportation, for the performance of which a railroad is constructed. In both of these things, as in many others, the public, because of its paramount interest, should be the final arbiter."

The Process of Coal Combustion.*

Three things are essential to combustion or burning in a locomotive firebox, as well as elsewhere. They are: The fuel to be burned; oxygen, the supporter of burning, and the igniting temperature of the fuel. Sometimes in our attempts to economize we apparently lose sight of two of these and regretfully watch the other disappear into the firebox. One person's regret may be due to the fact that the fuel is costing him money, while the other may be thinking of the fuel only in relation to the performance sheet. What is needed just now among all railroad men who have any immediate connection with the consumption of fuel is a concentration of attention on the interdependence of fuel, oxygen and ignition temperature.

The fuel used on most of our locomotives is soft or bituminous coal, and for that reason it will receive sole consideration in this discussion. Let it be said that *coal, as such, does not burn.* Before any burning can occur the coal must be broken down, which process requires an expenditure of heat. The first products of this breaking down process are coke and gases. The coke is made up of carbon (technically known as "fixed carbon") and those substances which help to make the

* J. W. Shepherd, Western Railway Club.

ash. The gases evolved are almost all composed of hydrogen (the lightest known gas) and carbon, therefore called hydro-carbons. These hydro-carbons must also be broken down into their components, hydrogen and carbon. Practically speaking, *the heat value of a ton of bituminous coal depends on the number of pounds of fixed carbon and number of pounds and relative composition of the hydro-carbon gases which will be produced upon heating it.* In general, the hydro-carbons are in excess of the fixed carbon, and the two together will usually average from 1,600 to 1,700 pounds per ton of coal.

The real process of burning in a locomotive firebox is the uniting of oxygen, a gas, with the fuel to be burned. In this *uniting process* heat is evolved and used in generating steam. If a sufficient supply of oxygen be present, a pound of carbon will burn to form a colorless gas, carbon dioxide (usually written CO_2), and enough heat will be evolved to convert 12.5 pounds of water into steam, the water to begin with being at the tank temperature, and the steam generated at a boiler pressure of 180 to 200 pounds. If, however, the supply of oxygen be restricted, then another colorless gas will be formed called carbon monoxide (CO), and but 4 pounds of water will be evaporated under similar conditions of pressure, etc. That is, with the same carbon to be burned one may get its full heat value or *less than one-third,* depending solely upon the supply of oxygen. A pound of hydrogen burned will evolve heat enough to evaporate 54.5 pounds of water under the above conditions.

The igniting temperature of carbon is a little more than 900 degrees (Fahrenheit); hydrogen about 1,200, and hydro-carbons from 940 to 1,230 degrees. There is no reason why these temperatures cannot be constantly maintained in a firebox.

It need hardly be mentioned that in obtaining fuel we must take what nature has provided for us, but in supplying the oxygen—which is just as necessary—man's skill is called into play. This important gas, oxygen, is a part of the air, being about one-fifth of it, by volume. Since it may be had for the taking, the enginemen's source of supply is the atmosphere and the extraordinary demand is met by an induced draft. At present this draft is produced by shooting the exhaust steam into the stack. Objections to this method are back pressure in the cylinders and the almost absolute dependency of the strength of draft on position of reverse lever, or cut off. This latter objection frequently manifests itself to the discomfiture of the fireman and also in the loss of fuel. The economic considerations of the present warrant the prediction that another method must supplant this one.

Not only is oxygen necessary for burning, but it must touch whatever burns. Right here is where locomotive men's troubles begin in earnest. It is not enough that the requisite amount of oxygen pass through the firebox in a given time, but its usefulness is largely determined by *just where* it is going through the box. To illustrate: Some time ago the writer had occasion to ride on a locomotive used in heavy freight service. This particular locomotive was known among the men as "the coal eater," and the reason was soon apparent, for practically all the oxygen was being pulled up through the forward two-thirds of the box and the fireman kept steam at the expense of fuel. Evidently the draft appliances were improperly adjusted. Other instances might be cited in which with apparently a proper adjustment of draft appliances similar results were temporarily produced on account of uneven firing. These illustrations are based on the improper utilization of grate area, and instances of "holes" in a fire and "clinkers" belong in the same category.

In an earlier part of this paper it was stated that of the two heat-producing factors from coal the hydro-carbons usually weigh more than the fixed carbon. About one-fifth of the weight of the hydro-carbons is the weight of the hydrogen which they evolve when broken down. And a pound of hydrogen, it will be remembered, is worth more than 4 pounds of carbon for heating purposes. It must be evident, therefore, that more than half the fuel consumed in a locomotive is consumed as gases. In this connection it is well to remember that when these gases are evolved *they do not loiter,* in order to be burned, but hasten at once towards the stack. One or two seconds' delay in burning them means their loss. If they remain intact they, being colorless, escape unnoticed. This is the condition that generally obtains when a fire is badly clinkered and the fireman longs for black smoke while his pointer continues to drop backward. No wonder the pointer goes back. Heat is expended in breaking down the coal, and then the best part of the fuel is simply thrown away. When a fireman produces black smoke he does so because he is partially, but only partially, burning the hydro-carbon gases, and thereby is getting *something* in return for the heat used in evolving them and breaking them down. Such a smoky fire will generate more steam per pound of coal than the smokeless, *cindery* one cited, but that does not justify the belief prevalent among some enginemen that a smoky fire is the best kind for steam. *Black smoke is unburned carbon from the hydro-carbons.* It is unburned usually because of the lack of sufficient oxygen. In this dearth of oxygen some of the carbon is partially burned to form carbon monoxide. Therefore the black smoke by no means represents the fuel loss from a smoky fire. *It is simply an indicator pointing to a loss.* In general a smoky fire is produced by putting the coal into the box in such a way and in such quantity that the hydrocarbons upon being evolved are not in contact with sufficient oxygen for their complete burning. Fires that roll out dense clouds of black smoke are not the only ones that waste fuel. A given amount of hydro-carbons requires a certain amount of oxygen for complete burning. But suppose there is an insufficiency of oxygen, then some of the carbon may be but partially burned, forming carbon monoxide, which is perfectly colorless. There is always danger of a loss of fuel in heavy firing, because of the large amount of hydrocarbons evolved in a given time.

Too much stress cannot be laid on the consideration of the hydro-carbon gases in locomotive combustion, for they are either the friend or the foe of the fireman just as he chooses to make them. If properly handled, they are worth more than all else he can get from his coal, or if improperly handled he may lose almost any portion of them and obtain black smoke besides. To secure proper combustion of these gases then, immediately upon being evolved they should be mixed with sufficient oxygen for their complete burning. On some roads a brick arch is used to assist in this mixing.

No stress has been laid on the burning of the carbon in the coke, because it simply lies on the grates and waits for the oxygen to come along. A fireman doesn't lose fuel from that source.

Since oxygen must touch whatever burns it is evident that coal should be finely broken in order to insure proper contact. At present too much coal is put into fireboxes in large chunks, and the hydro-carbons evolved do not have the chance to come in touch with oxygen as they *must* in order to be burned.

A word might be said regarding the influence of moisture in coal—also the practice of wetting coal—aside from the fact that it takes heat to evaporate this moisture. The steam generated from a quantity of water occupies about 1,800 times the volume of the water at atmospheric pressure. At a reduced pressure and high temperature, such conditions as one would find in a firebox, the volume would be correspondingly larger. Therefore water introduced into a firebox through any medium, upon becoming steam (and if not dissociated) occupies space that would otherwise be filled with other gaseous products. That is, the efficiency of the draft is impaired. This same effect manifests itself in firing on damp or rainy days.

As a concluding statement, permit the prediction that inherent objections to the present method of draft and the present form of fuel make a change in both necessary.

For pasting paper to iron or steel, mix Dexterine with water and boil it down until it assumes about the consistency of very thin glue; it will not hold on oily substances.

Letters From Practical Men.

Stopping Off from the Middle of a Pattern.

Editor American Machinist:

The order had come in for that special headstock we quoted price for the other day, charging 30 shillings ($7.50) on it

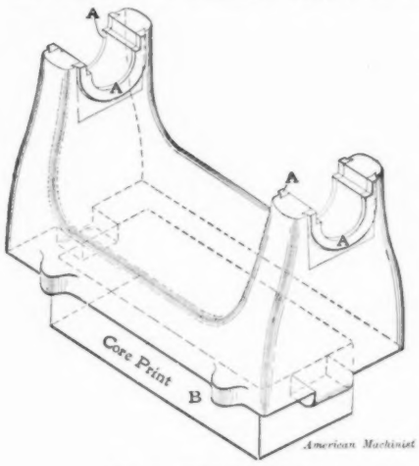


FIG. 1. THE PATTERN.

for the cost of making another pattern. It was to be exactly like our standard pattern, but 5 inches shorter. I had instructed the patternmaker to make the pattern, when it struck me that it might be possible to utilize the standard pattern. Upon first thoughts it seemed impracticable, however, to make this do, but after a moment or two's consideration the method shown by the appended sketches presented itself. I asked the patternmaker if he could suggest any way of molding the required headstock from the standard pattern, but after deliberation he answered "No." He "couldn't see how a piece could be stopped out of the middle." Taking the pattern into the foundry, I approached the foreman molder. "Can you make a casting off this, but 5 inches shorter?" After a moment, during which the wrinkling of his brow showed intense thought, he replied, "No, I can't; but I can make one 5 inches longer." Said I, "Suppose you go this way about it," explaining my idea. "Well, it might be made that way. Take it over to Charlie." Now, Charlie had exactly the same reply to my question, but after a re-explanation he promised to try. In about three hours he had the job finished, and when cast it was a splendid casting. An hour and a half's extra molding thus saved a couple of days' patternmaking. And this is how the job was done:

Fig. 1 shows the pattern; and it will be noted that as the casting is to be molded base up in an ordinary two-parted flask, it is necessary that the projecting facings *A* be loose. These were dovetailed on as shown. *B* is a core print. The middle portion of the pattern is parallel and of uniform section. The pattern was rammed up towards one end of the flask (see Fig. 2) in the usual way. After removing the cope, the pattern was withdrawn and replaced in the position denoted by the dotted lines, Fig. 2, the sand at *B* and *C* being removed to enable this to be done, and sand was then rammed into the spaces *B* and the space left by the upright *E*, the mold then presenting the appearance shown by Fig. 3. The parts of the sand at *D* were carefully rammed, as the mold of the upright at *D* would form part of the finished mold. The cope was now replaced, the sand was rammed carefully down to touch the pattern in its new position, the cope then removed, the pattern again drawn, and the space *F*, Fig. 3, filled with sand level with the joint of the box part, as shown at *F*, Fig. 4, which figure also shows the finished mold. Replace the cope and fill in the sand between the end and the first bar *G*. Remove the cope, and, using a piece of wood the same size as the core print is required in the shortened mold, stop off the original core print to the length as shown in Fig. 4, the original print being shown by the dotted lines *H*. The sand was roughly scooped out at *K*, and a bit of wood was used to reform the lug. The core was secured to the top and the mold generally trimmed up in the usual way.

I have forgotten to mention that the dovetailed facings *A*, Fig. 1, were withdrawn after the body of the pattern by drawing them in and up the spaces left by the uprights.

It will be clear that this method of molding, or rather stopping off, can be adopted in any case at all similar in its nature.

FRANCIS W. SHAW.

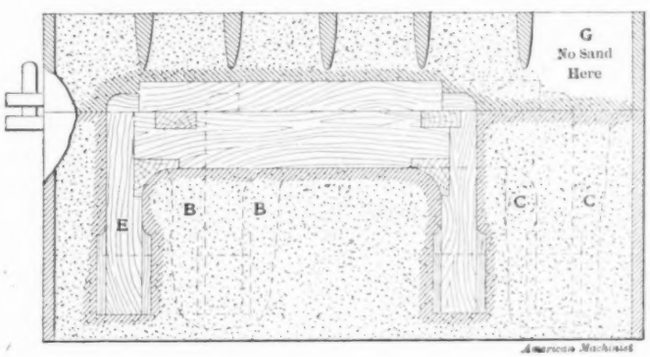


FIG. 2. FIRST POSITION OF PATTERN.

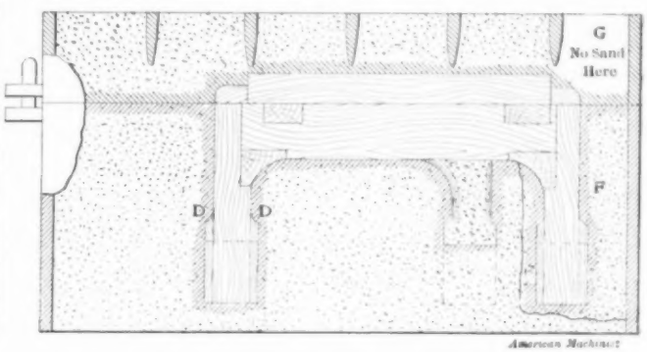


FIG. 3. SECOND POSITION OF PATTERN.

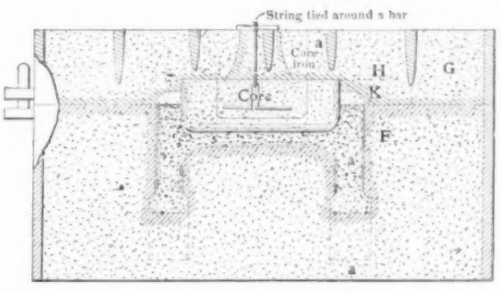


FIG. 4. THE FINISHED MOLD.

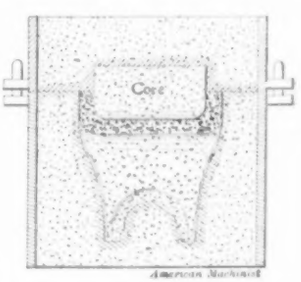


FIG. 5. CROSS-SECTION AT *a a*.

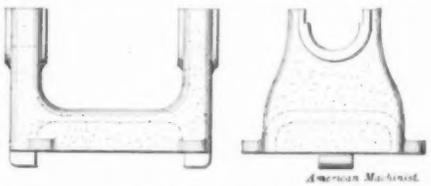


FIG. 6. THE CASTING.

Advice to an Apprentice Boy Again.

Editor American Machinist:

At page 1315 "Dutch" has a few comments on H. B.'s article at page 1056. I will state for "Dutch's" benefit that I was not one of the vaudeville actors nor the man who was discharged; I was the discharger, or, in other words, the foreman. When this boy engaged with me it was to learn the machinist trade, and I hired him to do the work of an apprentice and learn this trade. Now, it takes a lifetime to learn the machinist trade, as there is

always something to learn; but I taught him a trick of the trade in five minutes that he will not forget in a lifetime, if he wishes to get on in this world, and that is to mind his own business. Again, I repeat: Boys, if you want to get on and learn your trade, cut out this squealing business. You will never learn a trade from "Dutch" or from any other foreman. Keep your eyes and ears open and your mouth shut about things that do not concern you but only help to get you into trouble and bring the dislike of the men. Understand me well: the men, they are the ones to give you valuable pointers. I don't want to put old heads on young shoulders, and I would hate to put on some of the old machinists' heads that I have seen in my time.

"Dutch" says "H. B. must have been one of the vaudeville actors."

Yes, "Dutch," I am forty-five, and once in a while, when the boss is not around, I can make as big a monkey of myself as when I was eighteen learning my trade, and at the end of the day I have as much work to my credit as one of those men who go about the shop with a graveyard face.

"Dutch" says "H. B. might have advised the men to mind their own business." Here in Chicago, when one journeyman tells another to mind his own business, he stands near the fire escape while he is telling him. When your apprentice boy comes to you with a story about the workmen, tell him to sit down while you get a hammer handle; give him a little fatherly advice, tap him one on the coco as a reminder, and say "Gotlieb, my boy, that is your business *not*." H. B.

Machining Aluminum.

Editor American Machinist:

Some of those who have had trouble from aluminum castings tearing up under the tool, leaving a rough, porous surface, may be interested in the fact that we have found that the use of kerosene as a lubricant enables us to produce a good finish in turning and chasing, while lard oil gives excellent results in tapping.

The constantly increasing use of aluminum makes all items concerning its manipulation of interest, and I hope some of the brethren may tell us some of their experiences. I should like to know something about press-working and drawing it. L. O. Danse.

[There may be some disposition to exaggerate the difficulties of machining aluminum. In the present issue will be noted a description of dies for producing an aluminum box, and the writer suggests no difficulties in connection with the material used.—Ed.]

Milling Machine Feeds.

Editor American Machinist:

We have heard a great deal lately about the "all-gear" feed for milling machines and have been given to understand that this method of feeding a milling machine is a great advance upon all previous practice. Being of opinion that such is by no means the case, the writer respectfully begs to put forward a few arguments in favor of a different method of feed driving which appears to him to be not only more scientific in principle but to be productive of greater efficiency in practical use.

I am aware that the "all-gear" feed has advantages over the belt feed as usually applied, *i. e.*, driven from the spindle, but am of opinion that it has several serious disadvantages and dangers, and am even prepared to say that with the "all-gear" feed it is impossible, under certain not unusual conditions, to get out of the machine more than a fraction of the work which it should perform.

A considerable experience in the design of milling machines has convinced me that the correct way to drive the feed of a milling machine is from the countershaft, and in such a way that it is not affected by changes in the speed of the spindle. If this method is adopted, the same position or arrangement of the feed-changing mechanism always produces the same rate of speed, and the working of the feed gear is consequently much more easily understood than is the case where each position of the feed-changing device corresponds to as many speeds as there are spindle speeds, which is the case when all speeds are driven from the main spindle, whether driven positively or by friction.

The milling machine which will give the best satisfaction is the one which will produce the required quality of work at the highest rate, and as the *rate* at which work can be done depends entirely upon the rate of *feed*, the *speed* of the milling cutter should always be made subservient to the feed.

When experimenting for the purpose of finding the greatest rate at which a given piece of work can be done, the first step is the adoption of a certain rate of feed, which in the first instance is generally estimated, with experience as a guide. The next thing is to find out whether the speed of the milling cutter can be adjusted so as to enable the work to be done at that feed. If so, the feed can be increased and further adjustments of speed made until the highest rate of feed at which the work can be done is determined. If the opposite method is adopted, viz., first fixing the speed of the cutter, and then experimenting with the feed, it is probable that the final result will not be so good, and the process of finding the best speed and feed will certainly be longer.

With milling machines in which the feed is driven from the spindle the feeds are generally tabulated at so much per turn of the cutter, which seems to be an inaccurate method, inasmuch as it does not take into account either the diameter of the cutter or the number of teeth in it.

On a given piece of work a 2-inch cutter with 10 teeth should run at twice the speed of a 4-inch cutter with 20 teeth, but the feed should be the same for both cutters. If the feed be driven from the spindle and tabulated at so much per turn of the cutter, it will require adjustment to suit the varying spindle speeds for different sized cutters, whereas if driven from the countershaft, no such adjustment of feed would be necessary and nothing would require to be altered but the speed of the spindle. In cases where the countershaft of the machine has two or more speeds the feed pulley on the countershaft can be driven by an independent belt from the line shaft, and arranged so as to shift automatically on to a loose pulley when the countershaft is stopped, thus securing a constant speed of feed belt and at the same time preventing the feed from running on after the main spindle has been stopped.

The advantages of the "all gear" feed over a belt feed appear to me to be nonexistent, providing that the belt feed in question has sufficient power to do the heaviest feeding that is called for. The "all gear" feed may have, and undoubtedly has, advantages over a *weak* belt feed, but it is equally logical to say that a *powerful* belt feed has advantages over a *weak* gear feed. The fact is, there is no advantage in having a feed "positive"—*i. e.*, geared directly to the spindle providing that the alternative "non-positive" arrangement is sufficiently powerful for the work. The positive all-gear feed has the further disadvantage that breakages are very liable to occur should a jam take place, and this fact has been recognized by several prominent milling machine builders, who provide a breaking piece or slipping clutch in order to save their feed motions from serious damage in case of a jam, thus tacitly admitting that the so-called "positive" feed requires to be made "non-positive" in order to be safe.

It is quite true that many milling machines with belt feeds driven from the machine spindle have not sufficient feed power for heavy work, and it will doubtless be admitted that this is the result of driving by a belt from a spindle which at times runs at a slow speed, especially when heavy work is being done and when the greatest feed power may be required. If the feed belt is driven from the countershaft it can be driven at a constant and high speed, and ample power can always be obtained irrespective of the speed of the spindle.

In the workshop with which the writer is connected it is a regular practice to take cuts with very large face cutters requiring the slowest spindle speed (about ten turns per minute) with a feed of about 7 inches per minute, the feed motion driven from the countershaft, and it has been found impossible to do this with any standard milling machine at present on the market having feeds driven from the spindle, even

including those with "all gear" feeds, the usual maximum rate of feed on the slowest spindle speed being from about 2 to 2¾ inches per minute with such machines. A similar disadvantage exists at the other end of the scale with spindle-driven feeds. With the spindle running at its quickest speed—say, for example, 300 per minute—the minimum feed is far too high for the small cutters used at that speed, on account of the high speed at which the spindle drives the feed motion, and hence it has been found necessary to use on such machines high-speed milling attachments for speeding up the milling cutter without using the highest spindle speed, which, although provided, can yet seldom or never be used. With the countershaft-driven feed these disadvantages do not occur, as the range of feeds varying from, say, ½ inch per minute up to, say, 8 inches per minute, can be utilized with any spindle speed from the highest to the lowest. That the disadvantages indicated above *must* result from a spindle-driven feed can be shown by the following example:

Assume spindle speeds varying from, say, 10 up to 300 turns per minute, giving a 30 to 1 ratio of highest to lowest speeds.

Assume, as a suitable range of feeds for slowest spindle speed ½ inch up to 8 inches per minute, giving a 16 to 1 ratio of highest to lowest feeds. (The above ranges both of speeds and feeds are well within the usual limits.)

At the highest spindle speed (300) the above feeds would become 15 inches up to 240 inches per minute, as they would increase with the speed of the spindle and would of course be quite useless on the higher speeds.

Conversely, if the range ½ inch up to 8 inches per minute could be obtained on the highest spindle speeds, these feeds would be only 1-30th of that amount on the slowest spindle speeds and would also be of very little use, the highest feed for the slowest spindle speed being only about ¼ inch per minute.

In order to obtain the proper range (½ up to 8 inches) at all spindle speeds it would be necessary to have a total range of feed variation provided by means of the change mechanism giving a total ratio of (30x16) to 1 = 480 to 1, which is obviously impracticable.

What is generally done with machines having spindle-driven feeds is to adopt a compromise by which a fairly workable range of feeds is obtained for the medium spindle speeds with a bad range at the top and a bad range at the bottom of the scale, and an examination of the feeds provided with the majority of milling machines of this type will show that this is the case.

Another disadvantage of the spindle-driven feed is that it absorbs a large part of the belt power of the machine. With the feed driven independently the whole of the power of the main belt is used to drive the cutter, enabling heavier cuts to be taken than is the case where a considerable portion of the power of the main belt is used up in driving the feed. The main argument used against the independent feed arrangement is that the feed goes on if the spindle belt slips or breaks, and there is certainly some truth in it. At the same time it must be remembered that the spindle belt is not so liable to slip when it has not got to drive the feed as well as the cutter, and that even if a jam should occur from this cause it is not so likely to cause trouble or to break up a machine as in the case of a jam with the positive, spindle-driven, all-gear arrangement.

The independent method of driving the feed motions advocated above has been used extensively by a number of English and Continental machine-tool makers and, in my opinion, has many solid advantages over other arrangements.

The question is worth serious consideration both by milling machine designers and by buyers and the writer therefore suggests that a discussion in your columns by the advocates of the various methods of feed driving would be productive of good results and would probably end in something approaching unanimity in the principles of feed driving adopted by the various leading makers.

Coventry, Eng. P. V. VERNON.

[In the AMERICAN MACHINIST, eighteen years ago (September 20, 1884), the present editor contributed an article describing an arrangement of milling machine feed in which the feed was first driven at a uniform rate regardless of the spindle speed, and then from that as a basis could be varied to suit conditions. The difficulties referred to by Mr. Vernon were fully recognized in the article referred to, and a plan overcoming them was proposed which did not involve driving from the countershaft. In brief, the plan was to put a feed pulley on the spindle which was a reduced fac simile of the cone pulley in the countershaft. This drove a pulley which was a reduced fac simile of the pulley on the machine spindle. It is of course evident that this second pulley could be driven at a constant speed by changing the feed belt at the same time the main belt was changed. From the second pulley by gears and other stepped pulleys the feed shaft was to be driven. Shortly after the article in question was written the device proposed was made and applied to a B. & S. universal miller. Under date of September 24, J. E. Haeseler, who has charge of the toolroom in which this machine is at work, writes:

"I am still using the feed you inquire about and think it is all right. I would not like a feed from countershaft, as under a heavy cut or dull cutter the main belt slips off cone pulley, while the feed would try to keep on moving; whereas, if feeding from spindle, feed and cutter would act in unison."—Ed.]

The Trials of a Draftsman.

Editor American Machinist:

Being amused and likewise instructed by Mr. Danse's articles on drawing-room practice and the queer things that have arisen through their use and abuse, I wish to keep the ball rolling. Mr. Danse has seen some cases, but I doubt if he or anyone else has had quite as hard a row to hoe as I did when graduating from the shop to the drawing-room.

Some few years ago I left the employment of the firm that I had been with as toolmaker and draftsman, to accept a position as tool designer for a typewriter factory in the East. On endeavoring to learn how the men had been used to reading drawings, I found that no one system had been in vogue. Drawings had been made at haphazard and shown in both angles; in fact I found drawings in which the plan and elevation had been drawn in the first angle and the details in the third, and *vice versa*.

I determined to use the third angle entirely, and commenced accordingly. The first job I had was a pair of milling fixtures for a small cast-iron bracket, which went through all right. My next was a drill jig for the same piece. This jig was a small machine-steel affair with feet on five sides. The result was that when the foreman and the toolmaker put their heads together they read the drawing as though drawn on the first angle, and made a set of feet on the blank side and no feet on the side where they should have been. The superintendent sent for me and asked me to explain the reason why those feet were on the wrong side. I did so, but when I had finished he insisted that my drawing was wrong, and by way of an illustration he took the body of the jig and, turning it up on end on the sheet alongside of the plan, as though the drawing was a first-angle drawing, said, "That's the way it should be." When I attempted to tell him that the drawing was made in the third angle he asked me what in blazes the third angle was anyway. When I told him he claimed he had never heard of it before, and again took the jig and, flopping it over and over on the bench, concluded with: "Draw 'em that way." It is needless to say I did so.

But I was not out of the woods yet, by any means. Later on I had a drawing that necessitated four views, and of course one was upside down. Mr. Superintendent came along, looked at it, and said, "You are the first man that I ever saw make a drawing that a man has to stand on his head to read." I asked him how I should make it, and he said, "Blamed if I know, but it isn't right anyway," and he went away in a huff.

This same shop had some very bright toolmakers, and one day, on going down into the shop, I was greeted with: "Say! Hey there! We ain't got no screws like these here on that drawing." I picked up the drawing and asked the party what

was the matter, and he replied that the drawing called for 11½ threads to the inch. On asking him how he made that out, the answer I got was, "I measured them." I pointed out the detail of the piece, and he said "Oh," and shut up, and would not look at me for a week—felt injured, I presume.

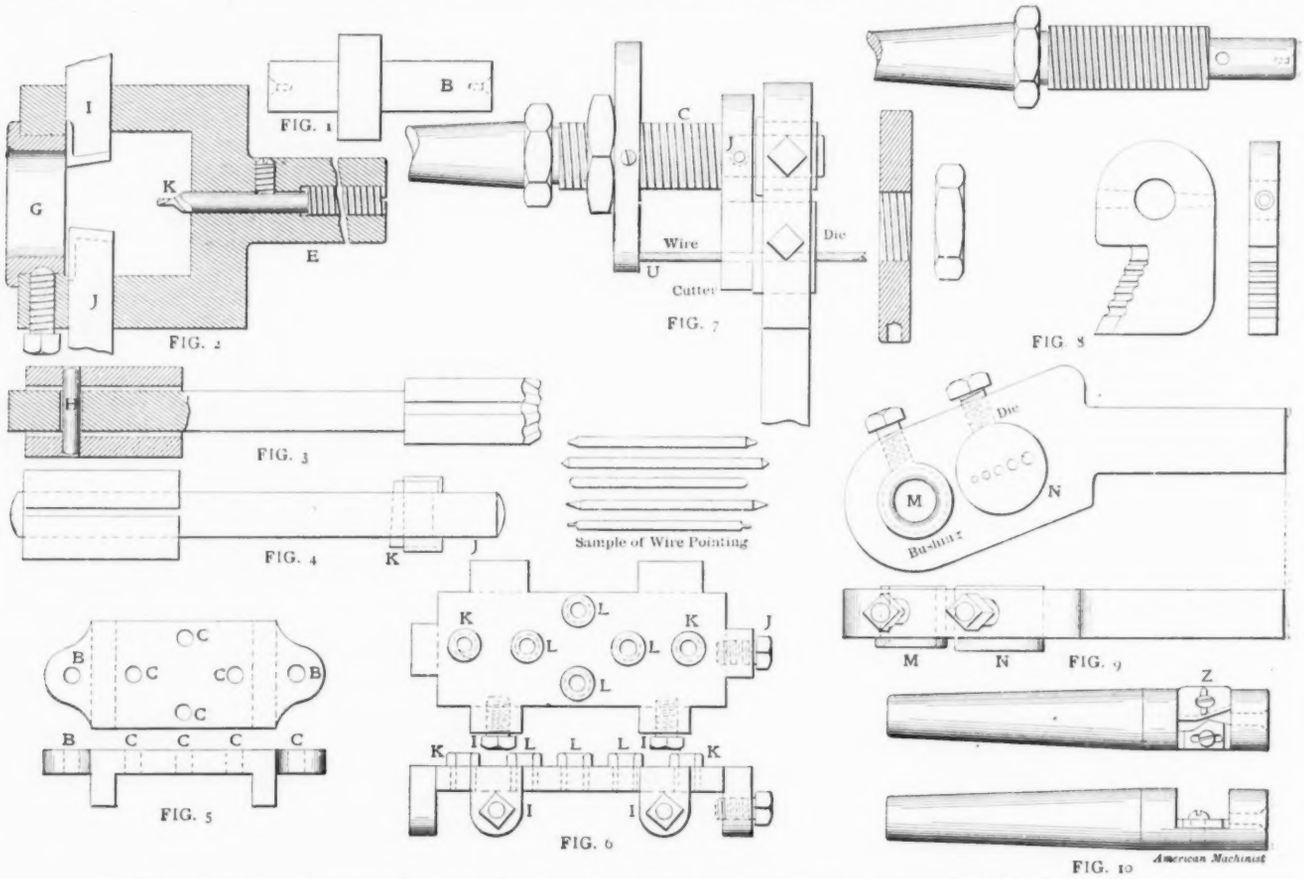
Later on I sent down a drawing of a die, with one view shown in section, which was given to this same man. The foreman came along to see how he was getting along, and found that he had the die all nicely cross-sectioned like the drawing, and was preparing to file it in for cutting edges, as he explained when questioned by the foreman. That was the last I ever saw of him.

I often found it convenient to change dimensions on a drawing without changing the scale, and when I did so I underscored the figures, in order to show that the drawing was not drawn to scale.

One morning a new man came on, and, as luck would have it, he got one of those doctored drawings, and went to work on it. I think he must have been a carpenter or a patternmaker in some previous existence, for he ignored figures without a qualm, with the result that about half he did do had to be thrown away and the rest put in shape by a man that knew enough to keep his scale in his pocket when it wasn't needed.

After that I would write a note in the upper right-hand corner whenever I had to change figures, saying "Work to figures and I am responsible; use your scale and you are.—Del."

So you can see that my initiation into the drawing-room was fraught with difficulties, and before I had been there very long I had about made up my mind that the life of a draftsman was anything but a bed of roses. I presume I was at fault in many cases, but between the superintendent and his "Draw 'em that way," and some of the men with their everlasting scales, I had all I could do to keep from making a bolt for the bench again. Before I left, however, I converted that superintendent to the ranks of third-angle drawing advocates and the men to a willingness to work to figures and let the draftsman take the responsibility. W. W. P.



BOX TOOL FOR ROUGHING OUT, BORING BAR AND REAMER FOR PULLEYS, DRILLING JIG, WIRE CUTTER, WIRE POINTER.

A Box Tool for Roughing Out—Pulley Borer and Reamer—Drilling Jig—Cutting Off Wire—Pointing Wire.

Editor American Machinist:

In Fig. 1 is shown a pinion blank. These pinions were of cold rolled mild steel, and were roughed out and centered at each end in the turret lathe. The box tool, Fig. 2, and a cutting-off tool were all that were required for the job. The box tool is finished from a mild steel forging, the stem *E* turned to fit the hole in the turret and the ends faced. It is then located on the head center and set to run true in the steady-rest, and the hole is bored in the face for the bushing *G*. A hole is bored and reamed through the stem *E* for the center drill *K*. Two cutting tools are let into the box—one, *I*, for roughing, set slightly in advance of *J*, which finishes. A set-screw for each, on the side, holds them in position. The bar of stock is held in the spring chuck, and the tools *I* and *J* are set to rough down the stem *B* of the pinion blank, leaving enough stock for a finishing cut in the lathe and then grinding. The use of these cutters in the box tool reduces the time on the work considerably.

In Figs. 3 and 4 are shown a fluted reamer and a cutter bar, which can be used in the turret lathe to advantage for finishing cored holes in pulleys and other parts. The cutter bar is fastened in the turret head by the split bushing. The manner of holding the tools is shown in the cross-section. Pin *H* drives tightly in the bushing, and the hole in the stem of the reamer is larger, so that when the reamer enters the hole in the casting it can follow it without side pressure.

In Fig. 5 is a plain casting, with two ribs on one side. It is first planed on the sides and a cut is also taken off the ribs. As the holes are clearance holes for bolts and studs, no great accuracy is required. The jig is shown in Fig. 6. It consists of one body casting with six ears on one side for the locating points and fastening screws. It is planed on the top, and then the inside is milled. Holes are then

drilled for the set-screws *J* and *II*. In locating the holes for the bushings, a casting, planed and ready to be drilled, is laid out, and the holes are drilled in the position and to the size necessary. This casting is then used as a gage, and by means of the screws *J* and *II* it is fastened in the jig. The holes are then transferred through it to the jig, enlarged and reamed to size. The bushings *L* and *K* are then driven in. The castings are drilled by fastening them within the jig, resting them on the faces of the ribs.

In Fig. 7 is shown a top view of a device for cutting wire. It is for use in the lathe, and can be operated with rapidity, the pieces of wire cut off by it being left with clear cut ends and free from the usual flattened appearance. In Figs. 8 and 9 the device is shown in detail. The stop bar or cutter holder, shown in the top sketch, fits the spindle of the lathe. The stop is screwed on and secured by the jam nut. The cutter is finished for cutting five sizes of wire, the largest being slightly over ⅛ inch diameter. It is made of 5-16 inch flat tool steel and fits snugly the reduced end of the holder and is fastened with a cross-pin. The cutting edge is worked out with half-round grooves of the radius of the different sizes of wires.

In Fig. 9 is shown the die and bushing holder, which is held in the tool-post of the lathe. The bushing *M* is lapped to fit the end of the cutter holder. The die *N* has the cutting dies let in and reamed to fit the different sizes of wire. The stop is adjusted to allow the wire to project to the required length, with the cutter running close against the face of the die. It is surprising how rapidly and clean cut the work is produced by the use of this device. It can be used for cutting all sizes of wire up to ⅛ inch diameter by making a few different sets of cutters and dies to accommodate them. Or it can be constructed to cut off wire of heavier gage by making all the parts stronger, and allowing the end of the cutter holder to run on the lathe tail center, as well as in the supporting bushing *N*. When the cutting tools become dull they can be easily removed and the face of each ground. The cutting holes in the die are reamed straight, and the grooves in the cutter are finished to the same shape and radius for the full width of the cutter. The amount of clearance given to the cutter should not be excessive, as when it is the edge will be found to be too frail and will not stand up well to work, especially when the material to be cut is Stubs wire.

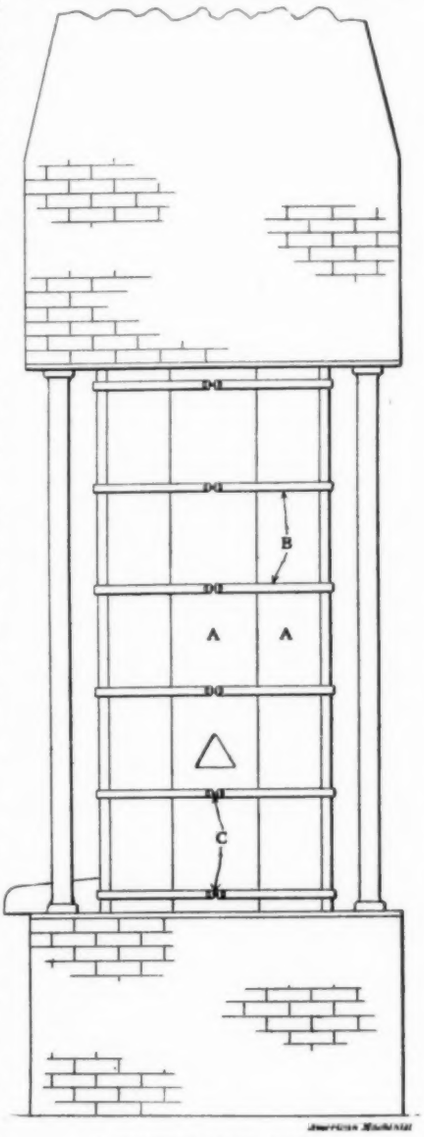
Fig. 10 shows a handy and inexpensive little tool for finishing the ends of wire of small diameters. The five pieces shown are samples of a large variety of different points which can be produced by the use of it. It consists of a taper shank holder finished to fit the spindle of the speed lathe, with a hole drilled in the face and reamed to the size of the wire to be pointed. A cross opening is cut for the cutting tool and the stop. The holder is placed in the speed lathe spindle, and wire to be pointed is grasped with a pair of plyers and fed in until it touches the stop plate. By changing the cutter *Z*, different shapes and points can be produced; and, by making a number of different sizes of bushings, a number of sizes of wire can be pointed.

PETER CHIAMPON.

A Foundry-Made Cupola.

Editor American Machinist:

In presenting the following description of a foundry cupola it is interesting to note the skillful use made by the builder —a foundry foreman—of the materials he had at his command in producing a good-working cupola at a small outlay. Although this cupola is now a thing of the past, having been displaced not long ago by a much larger one of approved design, we have no doubt that such of your readers as are associated with foundry work will take an interest in it.



A FOUNDRY-MADE CUPOLA.

As shown in the drawing, the cupola was 41 inches outside diameter and, when lined with 4-inch fire-bricks, about 32 inches inside. The most novel feature about it was the iron jacket, which was composed of eight cast-iron staves *A*, 8 feet high by ½ inch thick. These were bound together by six wrought-iron hoops *B*, ¼ inch by 1¼ inches, made in halves for convenience in assembling, and held together by bolts *C* through ears bent up on the ends of the hoop segments.

The two tuyeres, which were triangular in shape, were each placed in the center of a stave, opposite one another on the sides of the cupola, and were of the same capacity as the 5-inch round blast pipe leading into them. The cupola, with the exception of the hoops, was therefore all produced in the same foundry where it was used.

The cost of building was evidently quite small, being that of the pattern and flask for the staves, molding and casting eight staves, blacksmith work and drilling holes for the six hoops, together with the cost of iron, fire-bricks, and shop expenses.

The cupola did faithful service for many years, and the tuyeres were a specially good feature, for the reason that the bridge of cinder that forms around the tuyeres after running for a time, tending to close them up, took longer to form with this shape, and consequently gave a longer time in which to run off a heavy heat.

C. D. KING.

Sizing Blanks for Drawing.

Editor American Machinist:

In reply to Mr. Brown's criticism, at page 1455, of my article, page 1056, on the drawing of deep shells from sheet metal, and my method of obtaining sizes of blanks for the same, I would say that I hardly think Mr. Brown understands the subject as I presented it.

In the first place, I did not refer to stamped work, but to drawn work. In the second place, the methods of manufacture seem to be entirely different from the ones he seems to consider correct. The shells, being made in one operation in a double-action press, the metal undergoes a stretching operation, rather than a simple folding one, as in the stamping die.

Granting that Mr. Brown's formula is correct for his line of work, which I will not attempt to deny, I would hardly advise him to use it on work as is common practice here. Mr. Brown's formula allows nothing for the stretch of metal, or the well-known tendencies of brass and other alloys to increase in length proportionately with the increase in the length of the draw. Take, for instance, a shell used in the manufacture of an ordinary bicycle pump. The finished shell is 14 inches long and 1¼ inches in diameter; the original cup is 3⅜ inches in diameter and 2 to 2⅞ inches inches high, and the blank is 5⅜ inches. The shell goes through seven redrawing operations, and before

trimming is from ¼ inch to ⅜ inch too long, the metal being reduced from .033 to .024 inch in thickness. I think that Mr. Brown's simple arithmetic would give him a somewhat larger blank than I find necessary.

As for Mr. Brown's contention that it is always necessary to know the exact size of a blank before making the tools I can hardly agree with him, as all I find essential is an approximate diameter. I can design my tools accordingly. Although I will not vary in my figures more than 3-16 inch for large shells and 1-16 inch in the smaller sizes, I find it better to leave the exact size to the toolmaker to be determined by trial. His method of doing this is to leave his cupping die soft, without turning out the recess for the cutting edge, and he will first try the size I have given him, and, if correct, all right. If not he will get the exact size in two or three trials. This costs very little, and saves a great amount of waste metal.

This is of course only necessary on drawn work; the sizes for the majority of the stamped work can be determined beforehand, except in irregular work; I then find it preferable to use the trial method. In regard to the ordering of metal, most of the large stamping concerns of this country have the best of Mr. Brown, as they make their own metal, and are thus able to obtain what is needed on short notice. But most of the smaller firms use the same method, as brass is too expensive and the margin too narrow to allow for much waste in manufacture. In ordering their metal, the first lot may be 1-16 inch too wide, but, as large scrap is worth more than trimmings, they do not lose much, and the error is easily corrected on the next order.

Mr. Brown will find that this trial method is the safest in the drawing of shells that often equal the diameter in hight, and in fact in all one-operation drawing work. He will find that no exact rule can be relied on for this work, for the simple reason that more or less of the metal that goes into the sides is stretched, and as part of it comes from the base of the shell in stretching over the edge of the die, and as the amount is variable with the length of the draw and the number of redrawing operations necessary to finish the shell.

We probably do not do work in the same way as Mr. Brown does, but we pay dividends, and that is what counts, and our percentage of scrap is less than it would otherwise be. Hoping I have answered Mr. Brown satisfactorily, I will later submit drawings and explanation of our method of drawing deep shells.

EXPERIENCE.

An English Workman's Adventure on an American Lathe.

Editor American Machinist:

He was reputedly the cleverest turner in the shop, and the boss decided to put him on to the new American lathe, in order that it should have a fair trial. It was a 13-inch swing engine lathe, and well set out with the various little conveniences so dear to the American heart. The bosses had gone quite mad on American machinery; hence the appearance of the lathe mentioned in the shop. Their own lathes were of the real English type—the type which was not blessed even with the reversing motion or back shaft. To cut left-hand threads it was necessary to fix an extra intermediate change gear on the swing plate. For feeding the saddle along the bed, the screw had to be used, and the change gears were heavily compounded. Hence, to save constant gear changes, it was the habit to feed by hand the top slide of the compound rest. For facing—*i. e.*, turning at right angles to the lathe bed—owing to the absence of automatic feed, it was also necessary to feed by hand. Out of about forty lathes in the shop, only two—the American was one of these—had automatic feeds.

The American lathe weighed some 3 or 4 hundredweight more than any English lathe of equal size in the shop. Its wearing surfaces were better proportioned than those of the English lathe. In fact, it was a typical American lathe of the first water—one of those upon which an American can lick an Englishman into fits when on his own lathe.

Well, our man worked upon this new lathe for about three months. He had been an excellent timekeeper and one who took a keen interest in his work, although at the same time he was a "grunty" sort of a fellow, and not very talkative. It was noticed that he gradually appeared to lose his interest in his work and to lose quarters in the morning regularly.

Suddenly one day, for no apparent reason, he put in an appearance at the office. "I'm going, and want my money. Pay me up, as I want to clear out. I'm tired of the job."

"Why, Joe, whatever's the matter? We hope there's nothing wrong, as we shouldn't like to lose you!"

"I'm tired of the job." Beyond this no other explanation could be obtained for some time.

After pressure had been applied he said: "Give me my old lathe back and I'll stop. I can't turn out enough work to satisfy myself, and I know if I don't do this my employers won't be satisfied. I like to do a fair day's work every day; but I'll be hanged if I can do it on that d—— lathe. The Americans ought to be strung up for sending such —— rubbish into the country. If that's one of the best makes, what the —— are the common ones like?"

Now, this is a sample of a very common type of workman here. They are really useful men, and can turn out as accurate and good a job as anyone, but when it comes to the matter of speed they are far and away out of it. They seem to be quite incapable of understanding anything beyond the simple pioneer class of tool. All the little "trinklements" in time-saving attachments are utterly thrown away upon them. They cannot by any means get through the door which leads to modern modes of working. In short, to put the matter pithily, they are wanting in intellect. They know nothing outside themselves, and won't know anything. They resent any attempt to teach them their business, as interference unwarranted. They have learned all they know, not by study, but by observation and imitation. They know that a 20 gear into a 100, with a leading screw of ½ inch pitch, will result in a 10 per inch helix on their work; but ask them to gear up for 4¼ threads per inch, or ⅜ inch pitch, and they're utterly lost, and if they can't get to know from a fellow workman they will fix wheels by guess and cut a trial thread, which they measure.

The man I have referred to, simply because he knew only one way to do any given job, of necessity went that one known way about his jobs on the American lathe, and the American lathe was not at all suitable for his method of working; hence failure resulted.

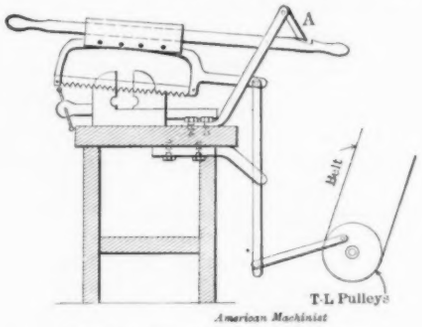
RIP VAN WINKLE.

Birmingham, England.

A Home-Made Power Hacksaw.

Editor American Machinist:

I send a sketch of a home-made power hacksaw; it is not very pretty, but it gets there just the same. There is not much machine work about it, as can be seen. It is secured to an ordinary machinist's bench and all the parts are made from



HOME-MADE POWER HACKSAW.

stock wrought iron, with the exception of the slide which is brass riveted to the blade frame. For holding the work an ordinary vise is used. The saw is not automatic, but a simple stop at *A* prevents the saw dropping after cutting through the work. When the apprentice has nothing to do, this is a good thing for practice.

COUNTRY BOY.

Foundation Drawings for Machine Tools.

Editor American Machinist:

No one, save those who have had occasion to work from foundation drawings of machine tools, can appreciate drawings that give all the desired information about

foundation bolts, belts, feed and direction of drive of countershaft, etc., etc.

Tool builders may think that all that is necessary in such drawings is a general outline of the machine, with the drive pulley shown, but without dimensions. Did it ever occur to them that in order to figure how much belting will be required for their machine the distance from the floor to the center of the drive pulley should be given, together with the drop of the countershaft hangers? If it ever did, why do they not put such information on their drawings?

My first experience in a drafting room was with a firm of machine tool builders. It fell to my lot a great many times to print copies of foundation drawings to be sent to purchasers of the different machines, and I often wondered how much help such drawings were toward the successful installation of the machines. These drawings were plans of the machines, and it would be impossible to determine how fast they should run, or if they should run from right to left or left to right. Such drawings as these are not worth the paper on which they are printed.

My first experience with blueprints for the setting of machinery was in a flour mill located in a little village of Ohio. A four-storied building had been erected for an organ factory, but as this did not materialize, the building was purchased by two local capitalists, and a firm at Indianapolis, Ind., was given the contract to install machinery in the building, the same being capable of producing fifty barrels of flour per day. The millwrights having arrived, with the assistance of a few helpers, including myself, the work was prosecuted in a most systematic manner. This for two reasons—first, because there was a perfect set of blueprints, and, second, because the millwrights knew how to work from them. I remember very distinctly how the foreman located the center line of the top floor, then bored three holes in the floor, on this line—one in the center of the room and one at each end. After plumbing down to the next floor, he was enabled to get the center line on it, and likewise until he reached the basement. The blueprints of the different floors had center lines on them. All measurements were given from three lines, and the foreman paid strict attention to the prints. To have seen that machinery start off without a hitch, as I did, would indelibly impress upon one's mind the importance of good foundation drawings.

Lately I have had occasion to make drawings for and to superintend the mechanical equipment of a locomotive repair shop, and while preparing the plans I had to depend upon foundation drawings from many of the leading tool builders of the country. It may seem rather strange when I say that I could not find a single print that could not be excepted to in some material way. These omissions on the various prints would have been of no great importance, had I been able to have set the machines on the floor, put up the line and counter shafts, and then, after each machine was up, sent a helper to the dealer for a drive pulley and sufficient belting. I have seen this done a number of times, but it cannot be done when one is situated 175 miles from a belt dealer, and when one's requisition goes through the stores and purchasing departments, respectively, of a railroad.

In the machine shop of this plant there are sixty-nine tools, driven in groups by five motors, ranging from 10 to 40 horsepower each. This arrangement requires 772 feet of line shafting, on which are ninety-eight pulleys operating 7,250 feet of belting. I have not the hardihood not to blush at the mere mention of the number of letters which passed between the builders of these respective machines and the head of the office, before an intelligent requisition could be placed for this material.

The size and style of the drawings vary as much as the machines which they represent. A number of firms sent cuts of their machines, taken from catalogs, with dimensions marked on them. One builder of power hammers sent a red and blue pencil sketch on yellow paper. The depth the foundation should be underground was given, as though one could tell what kind of ground it was to be set in, but it failed to show how high the hammer stood or anything about its drive. The builders were very much surprised when we asked for more definite information about the hammer. The information which we received was a cut of the hammer pinned to a sheet of yellow paper, the countershaft pulley being shown in pencil, "About 36 inches diameter," and the distance from the countershaft to the drive pulley was "about 5 feet." Definite information, indeed!

We also received a drawing for a 21-inch drill press, which was 21 by 33 inches—more area than the press itself occupies. There is not a dimension of any kind on this drawing. A 79-inch wheel lathe drawing measures 10 by 12 inches. This drawing would have been beyond reproach had the location of the cone been given.

My opinion is that if machine tool foundation drawings were constructed with the following points brought out clearly, no trouble would be experienced by the engineer in installing the machine, or in placing a requisition for the proper size of drive pulley and the required amount of belting:

1. A general outline of the machine should be shown, with the extreme dimensions given.

2. The centers of foundation bolt holes should be shown, with the thickness of the bosses or lugs through which they pass.

3. The drive pulley or cone should be located in relation to the center lines of the machine and the floor.

4. The diameter and face of the drive pulley or cone should be given.

5. The respective diameters and faces of all pulleys on the countershaft should be given, together with the distances at which they are located from the hangers.

6. The speed of the countershaft and the approximate horse-power are valuable.

7. The drop of the countershaft hangers, centers of bolt holes in the feet of the hanger and the distance one hanger is from another are important.

8. The width and thickness of all belts should be given.

9. If there are any belts on the machine, other than those from the countershaft, their width, thickness and length should be given.

10. If the machine is built for heavy work, such as a wheel press or wheel lathe, the floor line should be shown, so that the machine may be depressed in order that the work can be taken off from the floor and into the machine without a great amount of lifting.

C. D. McARTHUR.

Subtracting Fractions.

Editor American Machinist:

Many estimators and designers adopt various short cuts for performing arithmetical operations that save time and mental energy. Following is one for subtraction of mixed numbers when the subtrahend of the fraction exceeds the minuend. Reduce fractions to common denominators, subtract the difference between the new numerators from the common denominator and the remainder will be the required numerator.

Example: $16\frac{25}{64}$
$7\frac{39}{64}$
$8\frac{44}{64} = 8\frac{11}{16}$ ans.

Explanation: The given numerators 25 — 5 = 20; the common denominator 64 — 20 = 44; the answer = new numerator.

The same principle applies to the subtraction of inches and other denominate numbers.

Example: 9′ 7″
2′ 11″
6′ 8″ Ans.

Explanation: 11″ — 7″ = 4″, the number of inches in 1 foot, 12″ — 4″ = 8″ Ans.

One or two trial comparisons with the old way will convince the most skeptical that there is a distinct saving of mental effort in using the above method.

E. S. TIMATOR.

In our description of Hill, Clarke & Co.'s "Western" radial drill, at page 1473, a typographical error made us say, "The column casting is circular in section and double *at* the top." It was intended to say "double *to* the top." That is, the column is double all the way from bottom to top.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,400 copies are printed. Total for 1902, so far, 808,200 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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Next week the AMERICAN MACHINIST will publish an anniversary number in celebration of its twenty-fifth birthday. This number will be a notable one in many ways, and those who wish to be sure of a copy of that issue and who are not mail subscribers should order of the newsdealers in advance. The edition, though larger than usual, will be limited.

The Machinist and Labor Saving Machinery.

An engineer of our acquaintance was installing an improved machine tool in a machine shop not long ago, and, as he was standing by it shortly after getting it at work, a machinist employed in the place came up and in an undertone, but with much earnestness, said: "What do you New Englanders want to get up such machines as that for: to cut machinists out of their jobs? Why can't you be satisfied with tools as they are?"

We believe that this man's view of the matter was a mistaken one, but before an employer of machinists blames such a man employer of machinists blames such a man very much for taking that view, he should first ask himself how much study he himself has given to the influences that affect, one way or another, the demand for labor and therefore a workman's chance of obtaining steady employement.

Older readers of this journal will remember Chordal's treatment of this subject, and the boilermaker who objected to a new power riveting machine but could not refer to a boiler shop in which such riveters and other labor-saving machines were used that did not pay better wages and employ more men more steadily than did those boiler shops in which everything was done in the old-fashioned and more expensive way.

The fact that the use of labor-saving machinery, by reducing costs of manufacture, enables more people to buy manufactured articles and thus so stimulates the demand for them that more men are employed directly and indirectly has been so long and so often put forth that it has probably reached all workmen and others who can be influenced by it, but it seems to us that there is in the case of the machinist a special reason why he cannot consistently object to the use of labor-saving machinery in his own trade.

The machinist makes his living because other men are willing to use steam engines in place of tread-mills; power looms in place of hand looms; steam and air drills in place of the hand drill and sledge; steam-driven sawmills in place of the whip-saw; board planing machines in place of the jack- and smooth-planes; multiple, perfecting presses in place of the Franklin press; typesetting machines in place of hand set type; sewing machines in place of needles; locomotives in place of ox-carts and steamships in place of sailing vessels. If other people did not use these labor-saving inventions, the machinist would soon be out of a job. He gets paid for building machinery, practically all of which is designed to save labor and for him therefore to object to the use of such machinery or to attempt to restrict its output—which is the same thing as far as it goes—is absurdly inconsistent. Whatever others may do in their blindness to obstruct the progress of the world by preventing the full use of labor-saving machinery, the machinist or anyone concerned in the production of machinery certainly ought to be the last one to think of such a thing.

A workman whose stock of vitality is his only capital is justified in resisting any attempt to make him use up that vitality too fast and to become physically incapacitated before his time; but machines are not to be considered in the same way. They may be worn out or superseded as fast as may be and the machinist will have all the more work to do.

Topical Questions for Mechanical Engineers.

The following is a list of topical questions to be discussed or commented upon at the next meeting, in New York city, December 2-5, of the American Society of Mechanical Engineers. A list of the professional papers to be read at the meeting will be issued later.

What kind of oil burner have you found most satisfactory, and what are the essential requisites for successful operation?

What methods have you seen used for separating oil from exhaust steam, and with what success?

Has anyone used graphite successfully, over long periods, as a lubricant to replace cylinder oil?

What is to be the future of the apprenticeship system? What plans are now working well?

What are the minimum allowances of cylinder oil and new waste, per twenty-four hours, per 100 horse-power, in a power plant of ordinary size?

In tempering tool steel after it has been hardened, at what temperature does the tempering begin, and what temperatures produce what results? Does the time of subjection to the given temperature affect the result? What is the essential condition to secure best success? It seems to be established that the subjecting of hardened tool steel to the temperature of boiling water is sufficient to reduce its brittleness and increase its toughness.

What is the cause of the rapid deterioration of the tubes of surface condensers, in some cases, and how can it best be prevented?

Is there any limit to the increase of economy with the increase of temperature of superheated steam? If so, where is it and what brings it about?

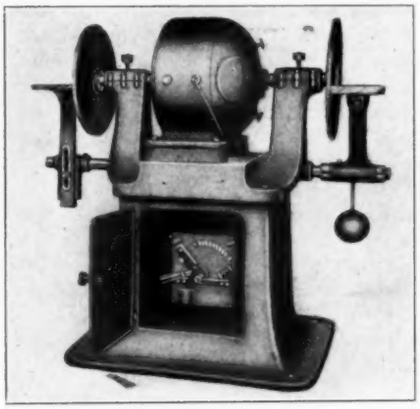
What are the best records of performance for gas engines using producer gas, and also for those using blast-furnace gas?

What type of gas producer has been found to give best results for gas-engine work?

Some New Things.

MOTOR-DRIVEN GARDNER GRINDER.

Our readers are familiar with the Gardner disk grinder built by Chas. H. Besly & Co., of Chicago, Ill. The illustration shows an electrically driven grinder recently furnished by this company for the new United States Mint at Philadelphia.



MOTOR-DRIVEN GARDNER GRINDER.

This machine is equipped with a Crocker-Wheeler 5 horse-power motor; the builders are prepared, however, to furnish the grinder with any of a number of other well-known makes of motors. The machine is provided with 18-inch disks and is known as the No. 40 grinder

COUNTERSHAFT REVERSING MECHANISM.

Upton & Gilman, of 587 Middlesex street, Lowell, Mass., have brought out a countershaft reversing device which requires but one driving belt, thus doing away with the extra belt and pulleys ordinarily employed for reversing countershafts. The half-tone shows a countershaft fitted with this mechanism, and the line engraving gives a good idea of the arrangement of the pulley and frictions.

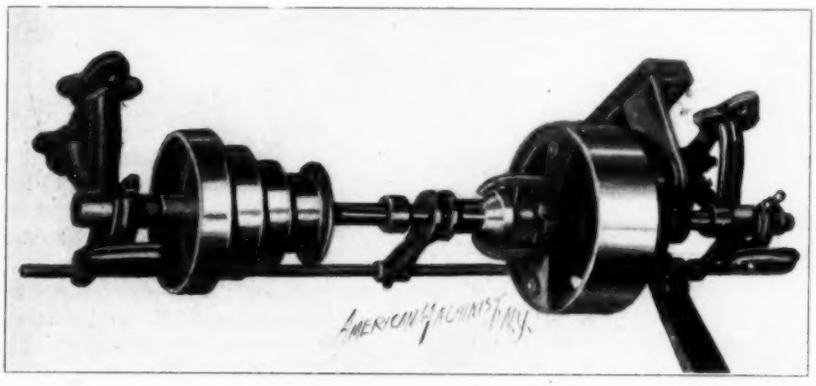


FIG. 1. COUNTERSHAFT WITH REVERSING MECHANISM

In Fig. 2, *A* is the driving pulley mounted freely on the shaft between friction *B* and disk *C*. A friction ring is formed in the pulley at *D*, and the inside of the pulley rim at *E* is beveled as shown. An auxiliary hanger *F* carries studs *G G* upon which are mounted to rotate freely rolls *H H*, the latter being tapered to correspond with the beveled edge of the disk *C* and the inner surface of the pulley rim at *E*. The studs, which are arranged to slide in their holders, are provided with springs which hold them back and keep the tapered rolls from coming in contact with the pulleys and disk, except when the studs are forced forward by the fingers *K* actuated by the sliding spool *L*. When the shipper is thrown over to start the countershaft forward, the fingers *M* are opened by the cone surface on *N*, and, the friction ring in the pulley at *D* being clamped fast between friction *B* and plates *O*, the pulley and shaft rotate together.

To reverse the countershaft the shipper is thrown in the opposite direction; fingers *K* are operated by *L*, and the tapered rolls

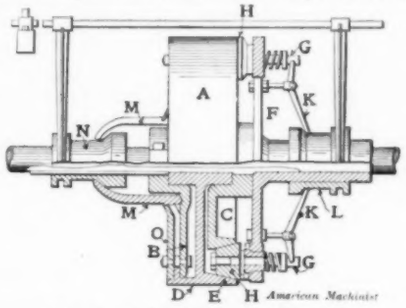


FIG. 2. REVERSING MECHANISM.

are forced ahead against the edge of the disk *C* and the beveled surface in the pulley rim. Thus the disk and shaft will be driven backward and will, of course, run at a higher speed than when driven ahead.

German Tariff on Machinery.

U. S. Consul-General Oliver J. D. Hughes sends us from Coburg the following account of the German tariff rates on foreign-made machinery, which, he says, are easy to calculate:

"Locomotives and portable machines pay a duty at the rate of 8 marks ($1.90) per metric centner (220.46 pounds); the duty payable on other machines depends upon the material which predominates; if chiefly of wood, 3 marks (71 cents) per metric centner; of cast iron, 3 marks (71 cents) per metric centner; of malleable iron, 5 marks ($1.19) per metric centner; of other metal, 8 marks ($1.90) per metric centner. These are now to be superseded by a complicated arrangement of various "progressive rates," dependent upon weight. Thus, we find that locomotives weighing up to 10 tons are to pay 11 marks ($2.62) per metric centner; those weighing over 10 tons, 9 marks ($2.14); locomotive tenders, 5 marks ($1.19); engines, motors, from 3 marks 50 pfennigs up to 100 marks (83 cents to $23.80) per metric centner; sewing and knitting machines without frames, 35 marks ($8.33); with frames, 20 marks ($4.76); curtain, lace and tulle machines, 10 marks ($2.38); machines for working metals, wood and stones, 4 to 20 marks (95 cents to $4.76); steam mowing and thrashing machines, 9 marks ($2.14); spinning and weaving machines, 6 marks ($1.43); other machines according to weight, from 3.50 to 18 marks (83 cents to $4.28); electro-technical products, 6 to 60 marks ($1.43 to $14.28); incandescent lamps, 120 marks ($28.56); vehicles for rails, 5 to 12 marks ($1.19 to $2.86); other vehicles, 20 to 150 marks ($4.76 to $35.70); and bicycles, 150 marks ($35.70) per metric centner. It can be easily seen how hard it will be to have these rates applied uniformly, in view of the latitude allowed to the appraising officials."

In his annual report to the Secretary of the Navy, Engineer-in-Chief Melville again expresses the opinion that the Navy Personnel Bill is a failure and does not accomplish what was expected of it. This we understand is due to lack of proper administration of the law rather than to defects of the law itself. Admiral Melville recommends also that the name of the Bureau of Steam Engineering be changed to Bureau of Engineering, and that it be given charge of all the machinery on ship board except that connected with the guns. This is in accordance with common sense, and would save lots of needless trouble, annoyance and expense. The present plan of having the electric-lighting engines, for instance, placed under the charge of the officer who is the lineal descendant of the candle lighter of long ago, and who frequently knows just about as much regarding machinery, is ridiculous and absurd.

Welding Aluminum.

Mary Wiszniewska Emmé, of New York city, has recently patented a simple process for welding aluminum by means of which she assures the public a perfect, homogeneous and permanent junction of the two ends of the metal may be accomplished. The following extract from the specification is intended to fully describe the process:

"I have discovered that by heating two contacting ends of aluminum under suitable conditions approximately to or above the temperature of 600 degrees Centigrade [1,112 Fahr.] welding can be effected.

"The invention consists in bringing the

two or more pieces of thoroughly cleansed metal or the two ends of the rods or wires of the metal into contact and applying a sufficiently high degree of heat to raise the parts to be united to the welding point, whereupon they may be welded together. To carry out my process successfully, the parts or ends to be united must be scrupulously cleansed before heating them to the welding point. The degree of heat required is approximately 600 degrees Centigrade and may vary, frequently requiring a slight excess. The correct temperature is reached when the aluminum commences to soften. By applying this heat when the parts are in contact they may be united or welded, whereby the mass or piece formed possesses throughout the same physical qualities as though the parts had never been separated—that is, the same tensile strength, the same flexibility, the same conductivity for heat or for electricity."

Meeting of the Society of Naval Architects and Marine Engineers.

The above-named society will hold its tenth general meeting at 12 West Thirty-first street, New York, November 20 and 21. Among the papers to be presented are:

"Why it takes So Long Time to Build and Equip a Naval Vessel for the United States." By George W. Dickie.

"The Water-Tube Boiler in the American Mercantile Marine." By Wm. A. Fairburn.

"Vibration of Steamships; with Special Reference to those of the Second and Higher Periods." By Rear-Admiral Geo. W. Melville, Engineer-in-Chief U. S. Navy, vice-president.

"The Possible and Probable Future Developments in the Use of Electricity on Board Ships." By F. O. Blackwell.

The Limit Gage System.

BY W. H. BOOTH.

The limit gage system has its limits also which come in the question of expense. During the past two years I have perhaps done more than anyone else in making public the limit gage system of shop working. I very rarely met any man who understood shop work and realized the importance of interchangeableness who did not like the idea or who did not wish to introduce the system into his works. I have met exceptions, of course, even among men who do really fine work, but who are content to muddle on with standard gages and thin paper for differences. Such men of course do not grasp fully the principles on which the limit gage system is founded. But the chief objection to limit gages is the cost of a complete set of solid gages, especially in shops where they have four types of fit, viz., shrink, drive, push and running. I am not arguing that so many fits are necessary in any shop, or at least not in such quantity as to demand a full set of gages for each type of fit.

Excepting the Whitworth people, there have been few or no makers of gages in this country, and people have relied on American productions. I am informed that some American gages are made to the United States standard yard, which is a very small fraction of an inch longer than the British standard. The difference, however, is quite sufficient to be measurable when it comes to a comparison of two 4-inch gages made on the two standards. But limit gages have attracted very little attention from any makers and do not seem to have been pushed by any American firm, beyond the allotment of catalog space, and when I took up the question in Great Britain and Ireland I found practically no acquaintance with the system either in railroad, marine engine, textile or other shops. Some few, of course, knew of the system and some had worked to it many years past, but the modern development was new to all, and quite a large number of firms took it up, more or less tentatively it may be in some cases, but with an intention to try its merits.

One of the main difficulties to contend with as regards the workman is that he will try to make a fit on the large end of the gage in place of allowing this to drop on loosely. He cannot at first disabuse his mind of the idea that a gage must fit, and unless he has been accustomed to naming small measures he does not at first realize how small is the difference between the two ends of a gage. Most workmen can work to much finer fits and differences than they know. If talked to of the ten thousandth of an inch, they are afraid. A thousandth still has terrors for men who will work much finer. In time, of course, they acquire confidence and allow the large end of the gage to go loosely on the piece, but at first a gage is very apt to be slightly expanded and soon it wears larger. A second gage will last much longer.

An English firm has now taken up the systematic manufacture of limit gages with a view to reducing the expense of the complete outfit. The form of the gage is the semi-circular crescent, and, in those which I have so far seen, the gage has two hardened screws at each face which can be screwed in or out for adjustment and gripped fast by transverse screws. Thus, at least in the larger sizes, each gage carries both limits. The Newall Engineering Company, of London, who make these gages, provide two systems of adjustment. In the first place, they provide hardened setting bars which are made to certain fixed limits and are probably the most convenient means of setting the adjustable gage.

But where there may be other fits not included in the stock of setting bars, the arrangement of setting is different and is to me novel, though the principle is old enough and simplicity itself. Each of the adjusting screws has a small centrally drilled hole in its face. Into these holes are slipped the spindles of small graduated disks, one disk merely carrying an index or zero mark, to which the zero point of the other disk can be set. The graduated disk extends a little over the face of the small index disk. The gage is first set to an absolute standard. The setting disks are then put into their places and the adjusting screw is turned until the disk has made a certain fraction of a revolution, each divison of the disk representing about .00025 inch. Having set one screw, the disks are then changed and the other screw is set.*

Such gages can be employed either on roughing limits, or any other fits and limits, and there is good reason to believe that they will be largely instrumental in helping forward the system of limit gages in British shops by getting over the difficulties against which I have very often run.

It is always satisfactory, when one has developed an interest in certain systems and methods and has spent weary months in spreading a knowledge of such methods, to find that the work is not wasted altogether, but that interest in the system grows even if oneself has become discouraged from lack of immediate interest in the development of it. The new adjustable gages are a very considerable advance on any previous gages I have seen, and the adjustable gage has caught on. I am aware of the arguments pro and con, but an adjustable gage is wanted and is asked for, and can often be sold where a solid fixed gage will not be entertained on account partly of expense and partly because of the difficulty I have named above. Manufacturers are often very uncertain as to what differences and limits will suit their particular work, and will not face the expense of solid gages that cannot be altered and are useless, while still looking as good as new, as soon as they become slightly worn. It is a little unfortunate for the limit gage system that what is known as the Admiralty system of sizes and fits is one which makes all turned pieces to standard size and makes all fit allowances in the holes. The gages of any type on this system are necessarily more expensive than when all holes are made to standard, and the differences and fits are made on the shaft. Large hole gages especially become very expensive, and though no doubt a full circle of a plug gage is the best form to employ, it would appear that end rods or tripod gages with one leg adjustable would fill the requirements of such a system.

The limit gage system, generally, will bear a lot of thinking about. There is more in it than the superficial observer will ever discover.

* The first system of gages was illustrated at page 179, and the second at page 1310.—Ed.

Technical Publications.

"Mechanics—Problems." By F. B. Sanborn. 155 5½x8-inch pages, with 62 illustrations. The *Engineering News* Publishing Company, New York. Price, $1.50.

This book is a collection of 500 problems for students in Analytical Mechanics. Many of them are similar to those found in the regular text-books, but, on the other hand, many have been developed from actual engineering conditions. In a few cases the solutions are given or indicated, but when this is done for any problem it is usually followed by others of the same class. The book will be found of large use by teachers of mechanics, who may find any required number of problems under the subjects of Work, Force and Motion, and the air of actual constructive work which hangs about many of them cannot do otherwise than stimulate a greater interest than do the usual highly artificial problems which are given by most of the text-books.

"A Manual of Drawing." By C. E. Coolidge. 178 6x9-inch pages, with 43 illustrations. John Wiley & Sons, New York. Price, $1.00.

This book is, we judge, the outgrowth of experience in teaching drawing, and is intended to give the instruction which every student draftsman must have but which becomes burdensome when oral teaching is depended upon. Much of the information given will appear to the commercial draftsman as extremely elementary, but, knowing something of the perplexities of the beginner and his proneness to magnify trifles and to belittle essentials, there can be no doubt that the instruction given is needed. The book is not a "drawing book" as that term is usually understood. Its aim is to show the conventions and short cuts of shop drawings, the way in which things are shown, rather than the over-elaborate way in which the student is apt to think they ought to be shown. These conventions and methods have been worked up from extensive correspondence with machine shops, a summary of which was given in an article by Mr. Coolidge at page 874, and the selections are intended to be such as to teach average, or at any rate common, commercial practice.

"The Slide Valve and Its Functions." By J. Begtrup. 143 6x9-inch pages, with 87 illustrations. D. Van Nostrand Company, New York; E. & F. N. Spon, London. Price, $2.00.

Our readers have some knowledge of Mr. Begtrup's knowledge of the slide valve through articles from his pen which we have published, some of which are included in the present volume, which is strictly modern and relates to present-day American practice, several valves and valve gears being shown which have not, we believe, been shown in any previous book. A chapter is devoted to four valve systems, including the Corliss, and a chapter is also devoted to pump valves. Professor Sweet's diagram is used throughout. The book is an excellent one.

"Elements of Mechanical Drawing." By A. P. Jamison. 69 7x9¾-inch pages, with 44 full-page plates. Published by the author, Purdue University.

This is intended as a beginner's book in mechanical drawing. It gives the essentials of projection and their application to the drawing of simple machine parts. Lettering is included and a good deal of attention is given to dimensioning, the examples of which are sensible and shoppy.

Personal.

Will our friend who signs himself "Tolly" kindly send name and address to the editor.

D. Clarence Durland has been elected second vice-president of the Sprague Electric Company. For the past three years he has been assistant general manager of the Sprague Company.

C. W. Spicer has purchased the business of the Watkins Machine Shop and Foundry at McComb, Miss. Mr. Spicer has been manager of the business for the past years and foreman of the shop for two years previously.

H. P. G. Norstrand, for the past two years superintendent of the Abendroth & Root Manufacturing Company, has resigned to take a position as general manager of the Hawley Down-Draft Furnace Company, of Chicago. He expects to take up his new work about November 15.

Col. Allan C. Bakewell, recently elected president of the Sprague Electric Company, was vice-president and general manager of the old Interior Conduit & Insulation Company, which was absorbed by the Sprague Electric Company some years ago. Previous to his present office he was for three years second vice-president and general manager of the Sprague Company.

A reader would like the address of the manufacturer of the packing called "Nickeline."

Commercial Review.

NEW YORK, October 27, 1902.

Not long ago the General Electric Company embarked in the manufacture of steam turbines, and expended considerable money in improving its massive plant at Schenectady, N. Y., for the purpose. From a business standpoint, the company's enterprise has been most successful. We have it from a trustworthy source that orders recently received by it for steam turbines represent over 75,000 kilowatts. Only a few days ago the company booked an order for one 5,000-kilowatt steam turbine from the New York Edison Company, for installation in its power station at Thirty-fourth street and the East River, this city. When put in operation this will be the largest single steam turbine installed in this country. In this connection it might be said, in passing, that the largest steam turbine at present in use is at the power station of the Hartford Electric Light Company, at Hartford, Conn., and which is 1,500 kilowatts.

The tests made by the General Electric Company on its steam turbines have been attended with most gratifying results, and to this fact the company attributes the large orders it has received for them.

Representatives of Southern pig-iron interests met in this city on Friday, for the purpose of considering the price they would place on their output for the last six months of 1903. After an animated discussion it was decided to charge $17 per ton at the furnace. With freight rates at $4.25 per ton from Birmingham, Ala., to New York, this means that foundries in this vicinity desirous of contracting for Southern pig iron for the latter half of next year, must pay at least $21.25 per ton for it, delivered in New York.

The price named by the companies will meet with general approval. In some quarters the impression has prevailed that the companies, taking advantage of the fact that American production of pig iron was not equal to the demands of home consumption, would decide upon an arbitrary price. The fact that the companies did not, is acknowledged to be good business judgment, since there is no telling what the future will bring forth.

It is interesting to note that when these same companies opened their books for the first six months of 1903, it was on the basis of $17 per ton at the furnace also. The demand for their product became so pronounced that the price gradually rose, until some iron has been sold as high as $23 at the furnace, although average sales have been made recently at prices ranging from $20 to $22 at the furnace. Recent reports indicate that the companies in question have already sold at least 90 per cent. of all the iron they are capable of producing for the first six months of next year. This fact, together with the action the companies took on Friday, shows the extraordinary prosperous condition of the pig-iron industry, and demonstrates that as yet nothing has appeared to doubt the continuation of the good times that mark the iron and steel domain at present.

In a recent issue, in this column, we called attention to the great surprise American manufacturers of electrical machinery experienced on being informed that the contract for the construction of a complete electric-lighting plant and tramway at Manchester, England, aggregating some $700,000, and for which several American firms had competed, had been awarded to the Allgemeine Electrical Company, of Germany. Recently one of the American firms which was after the contract received from its representative abroad some details concerning the Allge-

meine company's bid, from which we extract the following:

"I believe our company is in a position to manufacture many of the items in this contract as cheaply as any establishment that could be named, but from a close scrutiny of the Algemeine company's bid I cannot, for the world of me, see how it is going to come out ahead on the contract. You are well aware of the fact that the bid of the company was considerably lower than that submitted by others. I find that the chief reason is because the Allgemeine company put prices on items that are even lower than the minimum figure we can turn out the material they represent at our factory. This accounts, in a large measure, for the contract being given to the company."

The operations of foundries in many localities, particularly in the East, are still being seriously interfered with in consequence of the inability to procure fuel. Those using coke to melt their iron find the situation a very trying one. A few days ago a member of a large New York machinery firm visited a leading coke interest and was informed that at the present time they need at least 2,000 cars daily to transport their coke, but 400 cars have been the highest they have thus far been able to obtain. Reports from the coke region tell of a congestion of cars, due to the desire to get anthracite coal to localities where the demand for it has been particularly acute, in consequence of the recent strike. At foundries where hard coal is used in melting iron, the hope of a better supply in the near future is entertained.

The Electrical Equipment Company, Suite 939, Monadnock Building, Chicago, have been awarded a contract for the complete installation of a lighting plant for the city of Washington, Iowa. The equipment includes a Westinghouse three-phase 60-cycle generator direct connected to an Ideal engine. Work is now under way and the plant will be in operation about January 1, 1903. The same company have also been awarded a contract for the complete installation of a water power electric transmission plant for the Rouge River Light & Power Company, at Rockford, Mich. The equipment includes two General Electric generators and various motors ranging in size from 10 to 50 horsepower. The plant will be in operation December 1, 1902.

The Columbian Cordage Company, of Auburn, N. Y., has recently contracted with Westinghouse, Church, Kerr & Co., engineers, for an entire new generating equipment, comprising water-tube boilers, Roney stokers, economizers, mechanical draft, coal-handling apparatus and high pressure steam piping. The Columbian Company is closely affiliated with the Osborne Harvester Machine Company, the only independent concern manufacturing agricultural implements upon a large scale. The present boiler plant contains five water-tube boilers, hand fired, operating at 100 pounds pressure. The new plant will contain 1,575 horse-power boiler capacity, and the transformation will take place without disturbing the operating of the plant. The present brick chimney will be retained and used in connection with the mechanical-draft apparatus, as it is necessary to provide means to elevate to a suitable hight the waste acid gases resulting from the various chemical processes of rope manufacture. The plant is of interest not only by reason of the labor-saving appliances employed, but also for the peculiar engineering conditions imposed by manufacturing requirements.

The Chicago Pneumatic Tool Company report recent large sales of pneumatic tools to the Newport News Shipbuilding & Engine Company, Newport News, Va.; American Bridge Company, Philadelphia, Pa.; U. S. Navy Yard, Norfolk, Va.; Department of Public Works, Sorel, Canada; New York Shipbuilding Company, Camden, N. J.; Pressed Steel Car Company, Allegheny, Pa., and several others; all of the above sales being made as the result of competitive tests.

N. A. Christensen announces that the Christensen Engineering Company, of Milmaukee, Wis., with whom he has been connected as superintendent since its organization and is still engaged as consulting engineer, and with whom his other interests remain undisturbed, will hereafter manufacture his air compressors connected with air brakes exclusively. This will place under his control the manufacture of air compressors for all other uses. The previous correspondence in relation to such compressors not connected with air brakes for electric cars, together with the plans, specifications and patterns, have become his property. The air compressors furnished by him will be manufactured by the Christensen Engineering Company under his designs, specifications and inspection, insuring the same excellency in design, detail and workmanship which the products of this company have always possessed. It also leaves him free individually to extend the introduction of his system of air compressors in a rapidly extending field. There are now in use over 7,000 of these compressors of all sizes and capacities constructed under his patents and used for various purposes. Mr. Christensen's engineering and sales offices are located in the Herman Building, corner of Wisconsin street and Broadway, Milwaukee, Wis., where he will be pleased to see inquiring and interested friends.

Harry Huding, an American engineer, now at Para, Brazil, who has introduced various American machinery into that part of the world, writing from that Brazilian port, says: "There is a great future in Northern Brazil for American machinery and machine tools, and the field is almost unlimited. It needs only right business methods and thorough knowledge of the country and its needs to build up an enormous trade here in this line. I am so well convinced of this that when my present contract expires (in a few weeks) I shall immediately embark in the business of importing American machinery and tools and kindred products. I already have two important contracts for large factories to be erected as soon as I can devote my time to it. I have associated with me another American, Mr. E. A. Thomas, who speaks the language fluently and is familiar by long experience with the people and their customs, tastes and needs. We shall open a large warehouse centrally located, for which I have already contracted, and handle nothing but American goods. Here prospective purchasers and all interested in American manufactures may see samples and examine the goods at their leisure. This warehouse will serve as a supply depot for all Northern Brazil. I shall receive, on consignment or otherwise, as may be agreed, all kinds of American goods, though I shall make a specialty of machinery, and it is my firm belief that in no very long time I can build up a trade in American goods in this region which will revolutionize the business of Northern Brazil."

CHICAGO MACHINERY MARKET.

Heavy machinery for construction work cannot be turned out fast enough to supply the demand. Makers are months behind in their orders. Mining enterprises are numerous and active and railway construction promises much. It is particularly active in the Southwest—in Texas, Missouri and Oklahoma. Contractors in several known instances have undertaken to build each several hundred miles of new road in addition to projects now under way. They will be carried over into next year. New territory is being opened and new natural resources developed, particularly the lumber regions of the Southwest. The oil regions of Texas are calling directly and indirectly for considerable machinery. The demand for air compressors in the Texas oil regions is growing. Usually a high-pressure machine is wanted, one which is not regarded as a standard size, and hence the overcrowded builders are reluctant to undertake work of that description, having all the work of regular types which they can build. The demand for crude metal material shows the greater tension in the same direction of construction work. The three branches of the steel industry, which are sold far ahead into next year, are plates, structural shapes and steel rails, all having direct application to railroad and other construction work. Those branches of steel product which are consumed in the shops in lighter work, bars, sheets and merchant steel, are drifting towards an easier condition, not, however, because of a decreased demand, but because of the multiplication of producing mills, production having finally overtaken the keen demand.

The D. Clint Prescott Company reports its plant at Menominee, Mich., very busy; the inquiry for machinery in the Lake

Superior regions and for sawmill machinery in the South being ahead of their capacity.

The Ingersoll-Sergeant Drill Company is just about to ship to the Homestead Gold Mine, in South Dakota, an air compressor with low-pressure cylinder 52x72 inches, having a capacity of 9,000 cubic feet of free air per minute. A growing branch of trade is the portable air compressor plants used in bridge repairs and for other purposes.

Willis Shaw says trade is very brisk. Among his recent orders are an air compressor of 2,230 cubic feet per minute, to the Monroe County Oolitic Stone Company, Bloomington, Ill.; air-compressor plant to the Juliet Milling Company, Macon, Ga.; same to Parlin & Orendorff, Canton, Ill.; steam shovel to Sanderson & Porter, who are building, at Mishawaka, Ind., a dam to develop 20,000 horse-power for street railways; steam shovel to Erickson & Petterson, Chattsworth Park, Cal., and many others.

Quotations.

NEW YORK, Monday, October 27.

New York prices for Northern and Southern irons, largely nominal, are as follows:

Northern:

No. 1 X	$23 50	@$25 00
No. 2 X	22 75	@ 23 50
No. 2 plain	22 25	@ 22 50

Southern:

No. 1 Foundry	22 00	@ 23 00
No. 2 Foundry	21 75	@ 22 50
No. 3 Foundry	21 25	@ 22 75
No. 4 Foundry	20 25	@ 21 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.20c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11¾ @ 12⅛c.; electrolytic and casting, 11⅝ @ 11⅞c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 26.25 @ 26.75c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—5⅜ @ 5½c.

Antimony—Cookson's, 9½c.; Hallett's and U. S., 7¼ @ 7¾c.

Lard Oil—Prime City, 84 @ 86c., according to brand and quantity ranging from one barrel up to large lots.

New Catalogs.

The Carborundum Company, Niagara Falls, N. Y. "Carborundum and Where it is Made." An attractive little booklet, descriptive of the carborundum works.

Scully Steel & Iron Company, Chicago, Ill. General stock list, including pneumatic riveters, punches and shears, rotary beveler, etc. 4½x7, pp. 144, paper.

Hyatt Roller Bearing Company, Harrison, N. J. Bulletin No. 20, "Hyatt Roller Bearings as Applied to Heavy Duty and Heavy Moving Machines." 8x7, pp. 23, paper.

The Reeves Pulley Company, Columbus, Ind. The "Reeves" variable speed transmission, paper machinery edition. 6x9½, pp. 32, embossed paper cover, printed in two colors.

Brown & Sharpe Manufacturing Company, Providence, R. I. List of latest tools, including combination squares, combination sets, protractors and calipers. 6x9, pp. 10, paper.

The Tudor Boiler Manufacturing Company, Cincinnati, Ohio. Tudor feed water heaters, purifiers, filters and oil separators. Printed in two colors on pebbled paper. 6x9, pp. 9, paper.

Brown, Boggs & Co., Hamilton, Ont. Machinery for tinsmiths and sheet metal workers, evaporating machinery, can makers' and canning machinery, presses, dies, etc. 6x9, pp. 304, cloth.

The Link-Belt Engineering Company, Nicetown, Philadelphia, Pa. "Modern Methods Applied to Railroads in the Handling of Fuel and Steamship Lines in the Handling of Freight." 6x9, pp. 31, paper.

Manufacturers.

The "Katy Brass Foundry" is being built at Parsons, Kan., we understand.

The La Fayette (Ind.) Underwear Company will occupy a larger building.

August Hoffman, of Dexter, Mo., has purchased a site for a heading factory.

The Blakeslee Forging Company, Southington, Conn., will build a small addition.

The Perry Lumber Company, San Pedro, Cal., will, it is stated, build a planing mill.

It is reported that the Big Four Railroad will erect a repair shop at St. Joseph, Mo.

The Boston Sanitary Manufacturing Company has bought a factory at Malden, Mass.

The R. D. Pike Lumber Company, of Bayfield, Wis., will erect a double block shingle mill.

Wheeler, Osgood & Co., Tacoma, Wash., will rebuild their burned sash and door factory.

The Indianapolis (Ind.) Gas Company proposes to build a big artificial gas plant next year.

The Read Phosphate Company will build a $150,000 phosphate plant at Chattanooga, Tenn.

The St. Julien Gold Mining Company, of Livingston, Mont., proposes to build a new stamp mill.

B. F. Hill and M. Winemiller will move their handle factory from Winchester, Ind., to Attica, O.

The Gurney Foundry Company, Ltd., Toronto, Ont., is erecting new buildings at Toronto Junction.

A large addition has been commenced at the plant of the Automatic Machinery Company, Aurora, Ill.

The Backus Company, manufacturer of heaters, Brandon, Vt., has just built a machine shop addition.

A permit has been issued for a one-story building for the National Lock Washer Company, at Newark, N. J.

Warren, O., is to have a plant of the National Electric Lamp Company, which will employ 500 persons there.

The factory of the Cortland (N. Y.) Specialty Company, manufacturer of carriage hardware, has been burned.

The Rimmon Manufacturing Company, metal goods, Seymour, Conn., has found it necessary to enlarge its plant.

An addition is to be built to the plant of William Wharton, Jr., & Co., Inc., engineers, founders, etc., Philadelphia, Pa.

Plans have been prepared for a foundry, 102x181 feet, for the Detroit (Mich.) Foundry & Manufacturing Company.

Plans have been prepared for a plant of the Colean Implement Company, at East Peoria, Ill., to cost $125,000 to $150,000.

The Star Manufacturing Company, from Pendleton, Ind., is about building a 180x150-foot gas engine factory at Wabash, Ind.

Gaar, Scott & Co., Inc., agricultural implement manufacturers, Richmond, Ind., are erecting a structure for building engines.

A permit has been granted the Mayhew (furniture) Manufacturing Company, Milwaukee, Wis., for the erection of a plant.

The Jones & Laughlin Steel Company, Pittsburgh, Pa., is having plans prepared for the erection of a combination billet and rail mill.

The Nash Lumber Company will establish a mill near Glidden, Wis. James Nash, of Grand Rapids, Wis., will have active charge.

The Nashville (Tenn.) Bridge & Construction Company has purchased five acres of land and will erect a bridge shop and forge.

Fire occurred, October 18, in the plant of L. W. Pond Machine Company, Worcester, Mass., but damage is estimated at only $2,000.

An addition is being built to the plant of the P. P. Emory Manufacturing Company, coppersmith and brass founder, Springfield, Mass.

The Wallace Supply Company, of Chicago, has leased a factory at Somonauk, Ill., which it will use in the manufacture of railway supplies.

A sixth story addition, 56x152 feet, is to be built to the plant of the Lehigh Manufacturing Company, manufacturer of lace curtains, Philadelphia, Pa.

The New Home Sewing Machine Company, Orange, Mass., is planning to erect in the spring a four-story building in which to place the needle manufacturing department.

Plans have been made for a four-story brick factory, 53x100 feet, for the W. J. Scully Ventilator Company, Detroit, Mich. In connection with it will be a foundry, 40x80 feet.

Independent packers will, it is rumored, build a large packing plant in South St. Joseph, Mo., to fight the merger. Plants are also contemplated for several other Western cities.

The Sterling Electric Company, manufacturer of telephone supplies, etc., Lafayette, Ind., has purchased an additional building, which will be used for the wood work of its apparatus.

W. M. Welch & Co., Inc., school supplies, Chicago, Ill., will remove to Anamosa, Ia. In the desk and seat factory, book-binding, printing and lithographing departments will be employed about 400 hands.

The Pusey & Jones Company, Wilmington, Del., is preparing plans for a new building to be erected at the Delaware Pulp Works of the Jessup & Moore Paper Company to replace one wrecked by an explosion.

Work has been commenced on additions to the plant of the Martin-Anderson Company, manufacturer of agricultural implements, Omaha, Neb. Among the additions will be a foundry, a machine shop and a warehouse.

The Colorado State Board of Land Commissioners has decided to offer for sale a tract of land near Littleton, which contains forty acres. Application was made by F. R.

Caley to purchase it for a site for an iron and steel plant.

The machine shop of G. W. Hamblett, manufacturer of shoe and paper-cutting machinery, Lawrence, Mass., has been burned. Much of the equipment can be repaired. Temporary quarters are being taken to fill orders as quickly as possible.

The work of erecting the new buildings for the Sharon Foundry Company at Wheatland, Pa., is about being started. The company will manufacture heavy steel castings and ingot molds. Of the latter over 100 tons will be produced daily.

The National Tool Company (capital stock, $50,000) has leased factory quarters and power on St. John's street, New Haven, Conn., and will manufacture metal-working tools. The tools will be subjected to a special process of hardening steel.

The Electric Equipment Company, Reading, Pa., is entering into occupation of a temporary plant. The firm will erect the main plant, which will consist of a four-story building, with a machine shop and other structures, next spring.

It is reported from Chattanooga, Tenn., that the cotton manufacturing company for Ringgold, Ga., has been chartered, under the name Catoosa Manufacturing Company. W. H. Odell is president and secretary, and J. A. McClain, vice-president and treasurer.

New machine shops which will be built by the George J. Leyner Engineering Works Company, of Denver, Col., are to be located between Denver and Littleton. The entire plant is to be run by electricity, with individual motors for the larger tools, and three 20-ton electric cranes will be installed.

The recently organized Union Fire Arms Company, Toledo, O., is starting to build a 90x70-foot factory in Auburndale, to make single and double barreled and repeating shot guns. The officers of the company are: President, Geo. B. Colton; secretary, John H. Householder; superintendent, A. D. Elvin.

A company is forming in Baltimore, Md., to manufacture all sorts of steel castings. The idea originated with Charles T. Crane, president of the Farmers' and Merchants' National Bank and chairman of the executive committee of the South Baltimore Car Works. The new plant will be located at Curtis Bay, near the car works named, and at the start will employ from 300 to 500 skilled workmen. The company will make a specialty of railroad castings, including car couplers.

The American Excelsior & Machine Company, a newly incorporated enterprise, is building a two-story frame factory at the northeast corner of Twelfth avenue and Fourteenth street, Canton, Baltimore, Md. Jules W. Leroux is president of the company, and James R. Bates, vice-president and general manager. Besides making excelsior itself we understand that the company will build a machine for cutting it out of cord wood, and may later erect a larger factory and branch plants.

The Smart-Eby Machine Company, Ltd., Hamilton, Ont., manufacturer of pumps, engines, cranes, etc., has been succeeded by the Smart-Turner Machine Company, Ltd.; J. A. Turner becoming manager in place of Mr. Eby, who has gone out of the business. Mr. Turner is a graduate of the McGill University in mechanical engineering and has been with the Westinghouse Electric & Manufacturing Company, the American Tin Plate Company, the Hamilton Steel & Iron Company and John Bertram & Sons. The company has more work on hand than ever before, the list of present contracts being a long and creditable one.

The Toledo Stamping Company is a Toledo, O., concern just incorporated in New Jersey. Large buildings will be erected in the Toledo district. The officers of the company are: President and treasurer, Isaac Humphrey; vice-president and general sales agent, C. R. Miller; secretary and general manager, La Monte Bateman. The new corporation is made up largely of the shareholders of the Toledo Tube Company, which has been making shovels and has occupied a factory building in Auburndale. The Stamping Company absorbs this concern, and will manufacture large shovels, small scoops, skillets, umbrella rods and many other articles.

W. K. Palmer, consulting engineer, 401 New York Life Building, Kansas City, Mo., has been retained as consulting engineer for the American Carbolite Company, which has recently been organized for the purpose of building a plant at Constantine, Mich., for the manufacture of calcium carbide by a new process. Mr. Palmer and assistants are now in Chicago engaged in designing the electrical furnaces and special machinery required in the plant, and preparing plans for the arrangement of the equipment and for the steel building. The plant embodies many novel features—electrical, mechanical and structural—because of the unusual character of the process. Electrical power will be employed throughout the works.

Another large electric power plant will be established nine miles from Tacoma, Wash., by men who own the Snoqualmie Falls Power Company. Charles H. Baker and his associates in that company have secured control of the White River Power Company, which was incorporated several years ago as a New Jersey corporation. This company proposes to drain part of the flow of the White River into Lake Taps, whence the water will be carried over the high bluff near Sumner. This water power will generate electricity to the amount of 12,500 horse-power. The project has been consolidated with the Snoqualmie Falls power plant, and to accomplish this purpose the Snoqualmie Falls & White River Company has been incorporated with $2,000,000 capital. The company will transmit power to cities and towns scattered from the British line to Portland, Ore.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Metal patterns, single or gated. Leu & Co., L. I. City, N. Y.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Inventors and light mach'y.; jewelers' tools a specialty. Industrial Machine Co., Newark, N. J.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 129, AMERICAN MACHINIST.

F. L. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Wanted—A first-class machinery molder for high-grade work in small foundry; $500 to $1,000 stock required. Address D., care A. M.

A well-known practical M. E., having office in Pittsburg, would like to hear from parties desiring active local representation. Box 152. AMERICAN MACHINIST.

For Sale—Iron foundry located within 40 miles of Pittsburgh, Pa.; now running at full capacity and large trade to draw on. Box 104, AMERICAN MACHINIST.

Wanted—New or second-hand air compressor; capacity 280 cu. ft. free air to 600 lbs. pressure; vertical, belted type, preferred. Address Box 153, AMERICAN MACHINIST.

For Sale—Working drawings stationary type steam engine, 1 to 40 H.-P., eight sizes; first class in every particular; rare opportunity. Box 134, AMERICAN MACHINIST.

We manufacture on contract patented hardware specialties, tools, dies, metal stampings, special machinery, etc. Edmonds-Metzel Mfg. Co., 778 to 784 W. Lake st., Chicago, Ill.

Grinding beats filing; try us, on either hardened or soft work; capacity 7 in. diameter, 48 in. long and under. The Garvin Machine Co., Spring and Varick sts., New York.

Wanted—Bronze castings of intricate 350 lb. jacketed engine cylinders; castings must be close grained and possess high tensile strength at liquid air temperatures. Address Box 154, AMERICAN MACHINIST.

Wanted—Light machine work and special machinery to build to order, special tools, dies and punches; a well-equipped water-power plant and first-class workmen. The Bantam Mfg. Co., Bantam, Conn.

Wanted—Machinist, with from $1,000 to $2,000, to take an interest in and the superintendency of a concern manufacturing laundry machinery in Chicago. Address C. T. Cummins, 210 Larrabee st., Chicago, Ill.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

For Sale—New foundry, completely equipped, 60x380, on Erie Canal and Delaware & Hudson Railroad, near Albany; also complete machine shops and forging plant at Troy. Address Pneumatic Signal Company, Broad Exchange, New York.

Purchaser for small manufacturihg plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wanted—A man acquainted with the machine business, with from $10,000 to $20,000 capital, to take active interest in a proposed new manufacturing concern of wood-working machinery, in the South. Address "New Concern," General Delivery, Newport, Ky.

A Middle West manufacturer of standard machine tool in extensive use and bearing excellent reputation, wants man acquainted with New York machine tool trade; preferably (not necessarily) one now established and having storeroom; opportunity to represent other good makes; communication confidential. Address Box 96, AMER. MACH.

Young man, first-class mechanical and executive ability, good general, all-around machinist, first-class draftsman, familiar with up-to-date foundry practice, wishes to hear of an opportunity where he could invest a few thousand dollars; jobbing shop preferred; would not object to any part of the West, so long as the enterprise is in a locality where business can be secured. Box 94, AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Draftsman, Danish, desires position; small salary. Box 167, AMERICAN MACHINIST.

Mechanical draftsman seeks position in New York. Box 164, AMER. MACHINIST.

As foreman, by A1, progressive pattern-maker. K. G., care AMERICAN MACHINIST.

Mechanical draftsman wants position in New York. B. M., care AMER. MACHINIST.

First-class mechanical draftsman, experienced on Corliss engines, wants position. Box 172, AMERICAN MACHINIST.

Machine draftsman desires situation; first-class, experienced man on hydraulic work. Box 155, AMERICAN MACHINIST.

Young mechanical draftsman and engineer, with considerable experience in steam engine practice, wishes change. Box 146, AM. M.

A mechanical and electrical draftsman (Swede), technical, graduated in Germany, desires position. Address O. O., care AM. M.

Position wanted as general foreman or assistant superintendent; 20 years' experience on varied work; references. Box 147, AM. M.

A young machinist desires position as salesman or agent for machine house; necessary references. Address "Mechanic," P. O. Box 736, Atlanta, Ga.

A first-class toolmaker, experienced in manufacturing fine duplicate work, good business and executive ability, solicits correspondence. Box 171, AMERICAN MACHINIST.

Draftsman, graduate, experienced in mechanical, electrical lines; best references; situation with electrical concern preferred. Box 163, AMERICAN MACHINIST.

Technically educated and experienced mechanical draftsman desires change; over 3 years on machine tools; 1 year on electrical work. Box 166, AMERICAN MACHINIST.

Wanted—Position as foreman of toolroom in valve works, such as brass, iron, malleable and oil-well tools; 20 years' experience; West preferred. Box 162, AMERICAN MACHINIST.

Employment for about five months wanted by experienced technical man of 32, now draftsman with steel company; work that is not all drafting preferred. Box 168, AM. M.

Mechanical engineer and chief draftsman, 30 years old, Swedish technical graduate, desires change; 9 years' experience on air compressors, pumps and gas engines. Box 159, AMERICAN MACHINIST.

Lathe hand, with wide experience as operator and foreman in large tool works, desires change; up-to-date practice; can handle men and get results; reference furnished. Box 148, AMERICAN MACHINIST.

Mechanical engineer; experienced in equipping and managing shops; specialty, designing tools for rapid manufacture of repetition work; can develop small automatic casting process. Address Box 157, AMER. MACH.

Mechanical and electrical engineer and draftsman, of several years' experience, graduate of European polytechnical institute and well posted in modern machinery design, desires to change position. Box 161, AM. M.

Situation wanted by a competent, practical, up-to-date machine shop foreman, on small and medium work; can design tools, jigs and other fixtures for economically handling such work. Address Box 165, AMER. MACHINIST.

A practical machinist of experience in the shop on different classes of work and tools and outside erecting work is open for an engagement and prefers outside erecting work; can furnish the best of reference as to character and ability. Box 160, AMER. MACH.

Well-paying position of highest mechanical and business responsibilities desired by young man, successful in both, and who has no superior as engineer and practical expert in designing and developing machinery; 10 years present place. Box 173, AMER. MACHINIST.

Wanted—Position, by a thoroughly well posted and competent salesman; accustomed to closing large contracts, familiar with modern machinery and especially adapted to introduce a new line of goods or to open up new territory. Box 98, AMER. MACHINIST.

A position as general superintendent, by a thorough, up-to-date superintendent and M. E.; 15 years' experience; accustomed to engines, air compressors, gas engines and steam pumps; knows every detail from the pig iron to the finished product. Address Box 131, AMERICAN MACHINIST.

Mechanical engineer, 30, wants position as superintendent, master mechanic or chief draftsman; live man with 8 years' practical experience, special and mill machinery, tools, jigs, etc.; at present C. D. with large manufacturing company; write and get my references. Box 122, AMERICAN MACHINIST.

Wanted—Position as superintendent or general foreman, by young man with wide experience in machine work and the manufacture of interchangeable parts, electrical machinery, sheet metal goods, tool designing; energetic, systematic and thorough; a good executive and able to start up a new plant. Box 158, AMERICAN MACHINIST.

Young mechanical engineer; technical education; experience in shops, drawing room and on the road; at present employed as editor of engineering magazine, but wishes change; is a hustler and can get along with people; references from past and present employers. Anyone desiring the services of such a man address Box 13, AMER. MACHINIST.

Mechanical engineer, graduate Mass. Inst. of Technology, with shop and drafting-room experience in modern shop making interchangeable work, would like change in position; has had experience in handling work and men under both piece-work and premium systems and in estimating on contract work; can design jigs and lay out manufacturing processes; position as superintendent or assistant superintendent preferred. Address Box 139, AMERICAN MACHINIST.

Help Wanted.

Machinists—Your inventions developed by G. M. Mayer, M. E., Monadnock, Chicago.

Wanted—First-class milling machine hand; location Detroit, Mich. Address Box 150, AMERICAN MACHINIST.

Wanted—Experienced draftsman and designer of plate working tools. Address Y-42, care Lord & Thomas, Chicago, Ill.

Wanted—A good machinist, to fit up new machinery, also a good outside erecting man. Apply Box 145, AMERICAN MACHINIST.

Wanted—Non-union molders; good wages and steady employment. Address Ridgway Dynamo & Engine Company, Ridgway, Pa.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Machinists, send for free blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—First-class molder, to take charge of small jobbing foundry. Apply or write, Murray Mfg. Co., Richmond Valley, Staten Island.

Toolmakers wanted on jig and fixture work; high-grade men only need apply. Call on or address The Taft-Peirce Mfg. Co., Woonsocket, R. I.

Wanted—Man to take charge machine department, acquainted with bicycle work; also one good toolmaker. Address Day Mfg. Co., Lake View, N. Y.

Wanted—Draftsman on shop jigs and tools; must have had shop experience, be rapid and accurate. Address, giving experience, Box 170, AMERICAN MACHINIST.

Wanted—All kinds experienced engineers, draftsmen; send stamp to register; positions open. Cleveland Engineering Agency, Box 71, Station B, Cleveland, O.

Wanted—An experienced operator on a 36 in. three-head Ingersoll milling machine; must be an accurate worker. De Laval Steam Turbine Co., Trenton, N. J.

Wanted—Assistant draftsman on machine tool work. Address, stating age and experience, by mail only, N. B. Chace, 439 Shillito st., Avondale, Cincinnati, Ohio.

Wanted—Positions for experienced men, and men for such positions. Address James Brady (late Brady Mfg. Co.), Room J, 20th Floor, 220 Broadway, New York.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—An energetic, practical man as general foreman in large textile machine shop; state age, experience, qualifications and salary. P. O. Box 2815, Boston, Mass.

Wanted—First-class non-union molders, machinists and patternmakers; good wages and steady employment. Address Ridgway Dynamo & Engine Company, Ridgway, Pa.

Capable foreman, by machine tool company in Middle West; must lay out work on millers, lathes and gear cutters for 25 apprentices. Box 144, AMERICAN MACHINIST.

Working foreman wanted; must be a good, "all-round" machinist and with experience on outside work; good wages and steady work to the right man. Address Box 169, AM. MACH.

Wanted—First-class office man; one familiar with hardware or machinery business preferred; give age, experience, references and salary expected in answering. Box 120, A. M.

Wanted—Foreman for small-tool department in manufacturing plant near Chicago; must be capable of accurately working to plans in making interchangeable parts. Box 149, AMERICAN MACHINIST.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—An experienced young man, for buyer and seller in a small foundry, machine shop and supply business; also two traveling salesmen for same; state age, experience, wages, references and whether married. "West Virginia," care AMERICAN MACHINIST.

Wanted—Machinists, toolmakers, floor hands, bodymakers, painters, trimmers and blacksmiths; we have just moved into our new factory and will double our present force; good wages and 9 hours' work. Address Fournier-Searchmont Automobile Company, Trainer, Delaware County, Pa.

A good designer is wanted by a firm building a line of grinding machinery; should have experience in this line and some experience in patternmaking; a man with good ideas is wanted more than an expert draftsman; write fully as to age, experience and wages expected. "Massachusetts," care A. M.

Wanted—Toolroom foreman, by large machine tool factory. A man thoroughly familiar with making of jigs, gages and first-class toolroom systematizer wanted; must be sober, industrious and married; splendidly equipped shop in city of 25,000 people, located in Middle West; state experience and give full and complete information. Address Box 151, A. M.

Wanted—Machinists for night work, of all branches of the trade, such as toolmakers, hands on lathes, planers, boring mills, milling machines, universal grinders; Gisholt, Potter & Johnston and all other types of chucking and screw machines, floor, vise, etc.; steady work for first-class men on light and medium interchangeable work. De Laval Steam Turbine Co., Trenton, N. J.

Position for young man, technically educated preferred; must have good executive ability and be capable of planning his work and getting it done; capable of organizing his department and enthusing and developing those around him; must be capable of taking charge of a toolroom having 15 hands; good chance for experience and further advancement; state age and experience, salary and references. Box 156, AMER. MACHINIST.

Wanted—Toolmaker, one having had practical experience in making tools, such as drilling, milling and planing jigs for duplicate parts of medium size machinery; must have had experience in designing tools as well as in drafting; must also be able to look after several men in tool-making department; a knowledge of German preferred, but not absolutely necessary. Answer, if possible in German, stating experience, where last employed, whether married or single and what wages last received, to N. W., No. 999, Postlagernd, Francfort o. M., Germany.

To improve our electrical machinery works in Milan, Italy (400 men), we invite application as works manager; must have recommendations from a similar position; prove ability to organize shops for good, cheap and prompt work; thoroughly know modern machine tools—use of them, handling of men, making up of costs; have some practical knowledge of electrical winding, and rapidly acquire Italian language; free hand; good permanent position to him who can prove the right man. Address, with age, experience, reference, salary expected and full details to save lengthy correspondence, Dr. George Finzi, Milan, Italy.

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Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.

Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Band Saws

American Machinery Co., Grand Rapids, Mich.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Philadelphia, Pa.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Mchry. Co., Tiffin, O.
Reade Mchry. Co., Cleveland, O.

Blocks and Tackles

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers

Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Ray Automatic Mach. Co., Cleveland, O.
Reliance Mach. & Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Bulldozers

National Mchry Co., Tiffin, O.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Books, Mechanical

Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.
Van Nostrand Co., D., New York.
Wiley & Sons, John, New York.

Carborundum
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Car Link Machines
National Machy. Co., Tiffin, O.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Miami Brass Works, Hamilton, O.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Allegheny Fdry. Co., Warren, Pa.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Coil Clutch Mfg. Co., New York.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
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Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandergrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting-off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cincin., O.
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Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.

Drilling Machines, Upright—*Cont'd*
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Cooper Mach. Co., Saltsburg, Pa.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New England Gas Engine Co., Boston, Mass.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wk., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Worm
Aibro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Russell, R. M., Binghamton, N. Y.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Frasse Co., New York.
Goodell-Pratt Co., Greenfield, Mass.

Grinding Machines—*Continued*
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Russell, R. M., Binghamton, N. Y.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Frasse Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Enginering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Stm. Boiler Ins. & Insp. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Co., Wm., Cincin., O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Frasse Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mach. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Gardam & Son, Wm., New York.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Brown & Sharpe Mfg. Co., Providence, R. I.
The Adams Co. Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co. Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.

Motors, Electric—*Continued*
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, Ohio.

Patents
Baldwin, Davidson & Wight, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Prentiss Tool & Supply Co., New York.

Patterns, Wood
Gardner, H. W., Waukegan, Ill.
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Ct.

Pencils
Keuffel & Esser Co., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co. T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Iroquois Mach. Co., Providence, R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Second Hand Machinery—*Cont'd*
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Manchester, N. H.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
National Mchry. Co., Tiffin, O.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Wilmington, Del.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Spike Machines
National Machy. Co., Tiffin, O.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
The Chandler Co., Springfield, Mass.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Mach. Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
National Mchry. Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Mchry. Co., Tiffin, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Winter Bros. Co., Wrentham, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster, Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer Machines
National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., Provi., R. I.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wood Working Machinery
American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.